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ABSTRACT

Designed to assist students in understanding solid waste resource recovery, this teaching aid package aims to get students involved in practical activities that require participation, observation, and interpretation. Provided in this package are definitions, methods, causes and effects, costs, and benefits of resource recovery presented in the form of behavioral objectives suitable for use in curricula of grades 4 through 12. Major sections include: (1) a scope and sequence (specifying 13 subject areas with sub-topics in an outline form); (2) objectives, activities, exhibits, and fact sheets (presenting materials and information for each of the major subject areas); (3) references (containing the bibliography for the teaching guide and listings of references on properties of waste materials, thermal processing, biological processes, sanitary landfill, disposal at sea, and other sources of information and assistance); (4) glossary (containing definitions for terms associated with solid wastes); and (5) Florida Projects (providing a listing of Florida's governmental and private resource recovery facilities and a listing of Florida's small scale recycling projects). (ML)

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Teachers Aid

RESOURCE RECOVERY

SE047492

FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION

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RESOURCE RECOVERY

Energy and Environment

TEACHER'S AID

PREPARED FOR FLORIDA'S
DEPARTMENT OF ENVIRONMENTAL REGULATION
SOLID WASTE SECTION

in cooperation with

DEPARTMENT OF EDUCATION

OFFICE OF ENVIRONMENTAL EDUCATION

Prepared by

Reynolds, Smith and Hills
Architects-Engineers-Planners
Incorporated

June 1980

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FOREWORD

Currently the average citizen generates approximately four pounds of solid waste per day. In all of Florida, over thirteen billion pounds of solid waste will be generated in 1980. By 1990 this figure will have increased to seventeen billion pounds annually. Over this ten year period the wastes will be equal to a volume that would cover every interstate roadway in Florida to a depth of over four feet. Disposing of this amount of solid waste in a safe, environmentally acceptable and economic manner is a challenging solid waste management task.

Local and state officials responsible for solid waste management in Florida have the responsibility of guarding against the hazards of improper solid waste disposal such as fly, mosquito and rodent breeding, fires, water pollution from stormwater drainage, litter, and other risks to the general health and safety of the community. The same officials are also charged with promoting effective solid waste disposal at the lowest possible cost.

These two objectives rarely coincide. With Florida's growth in the last ten years, safe and environmentally acceptable solid waste landfilling operations have become difficult to establish. Sufficient and adequate land near the areas of waste generation is hard to find. When available, it is usually too expensive for landfill use. Remote landfill acreage is the next solution usually sought. This means transfer stations and expensive transporting operations.

The situation demands more attention as Florida grows. It also demands more attention as the resources in the wastes we discard become more valuable.

Increasing national and worldwide consumption is placing heavy demands on limited supplies of raw materials and on the energy needed to process these resources. The solid waste we discard is now considered a source from which resources can be recovered for reuse. In addition to materials, solid waste contains energy, an extremely important resource.

State and Federal regulations have been implemented which encourage resource recovery and safe landfill disposal. In 1974 the Florida Legislature passed the "Resource Recovery and Management Act of 1974." This act promotes the "application of resource recovery systems which preserve and enhance the quality of air, water and land resources." The Department of Environmental Regulation (DER) was given the responsibility of developing a statewide resource recovery and management program, including solid waste storage, collection, transfer, disposal and recycling.

Subsequent DER requirements have mandated resource recovery feasibility analyses in nineteen counties of the state. Resource recovery is required where studies demonstrate economic and technical advantage. Details of requirements are defined in "Rules of the DER, Chapter 17-7, Resource Recovery and Management."

The U.S. Resource Conservation and Recovery Act of 1976 strengthened Florida's regulatory move toward controlling solid waste disposal and encouraging resource recovery. Since the passage of this Act, the Environmental Protection Agency (EPA) has established an Office of Solid Waste. Among other duties, EPA administers financial and technical assistance for planning improved solid waste management programs. The Agency has recently published a hazardous waste regulatory program requiring identification monitoring of some wastes from the time of manufacture to their ultimate use and disposal.

Because of the initiative of local and state interests, and added emphasis of the above regulations, many programs are already underway in Florida which recover resources from solid waste. These programs not only save resources, but also reduce landfill requirements. The trend is established. Technology and economics have already made resource recovery from solid waste a viable alternative to traditional landfill disposal. As resources become more valuable, and as landfilling becomes more expensive, this trend will strengthen. The best assurance that your community is participating to the greatest advantage in resource recovery is an accurate, perceptive knowledge of solid waste management factors. This program is intended to provide the student an exposure to at least some of these factors. It should also develop an awareness of each community's responsibility to protect our limited resources and reduce landfilling dependency through resource recovery programs.

INTRODUCTION TO THE INSTRUCTOR

The purpose of this teaching aid package is to introduce the instructor and, in turn, the students to the developing area of solid waste resource recovery. Other curricula exist which deal with the subjects of air and water pollution, energy and natural resources, life cycles, and environmental ecology. The attempt herein, is to assist the student in understanding solid waste, its pollutants, and energy losses; its material, energy, and economic recovery opportunities; to help motivate the student to become involved in or responsive to resource recovery in his community, his county, his state.

The problems and solutions of solid waste disposal are a major area of resource recovery. The student must be made aware of the existing problems, and become familiar with the science and technology of waste disposal and recovery. As our attitudes toward the individual facets of solid waste resource recovery and our awareness of the hazards and benefits are basic to solving our pollution and energy problems of solid waste, the students should be required to instigate public concern in some manner. They must understand the implications of solid waste disposal and recovery to themselves, their family, and society in general.

Provided in this package are definitions, methods, causes and effects, costs, and benefits of resource recovery presented in form of behavioral objectives suitable for use in curricula of grades 4 through 12. In development of their attitudes, students should involve themselves in practical activities that require participation, observation, and interpretation. They will be required to read, analyze, and apply available information for problem solving. Some activities are oriented towards literature and library research, while others emphasize field and "hands-on" activities. Teachers should consider the suggested activities as a guide only. Others more applicable to specific classroom interests may come to mind when reviewing this package. The important point is to get student participation in at least one area of solid waste resource recovery.

Generally, it is more important that the student understands the abstract concepts than accumulate data in basic study of resource recovery. The intent is that a more ambitious student may continue his studies in this subject area toward greater detail or more global research effort. It is anticipated that each student will be encouraged to develop individual insights and responses to todays resource recovery challenge.

SCOPE AND SEQUENCE

SCOPE AND SEQUENCE

I. Definition of Resource Recovery (1.0)

A. Any process in which matter or energy traditionally discarded is recovered for reuse.

II. Resource in Solid Waste

A. Types of Solid Waste (2.0)

1. Agricultural
2. Construction Debris
3. Yard Trash
4. Hazardous Wastes
5. Industrial Wastes
6. Municipal Wastes

B. Generation of Solid Waste (3.0)

1. Process
2. Quantity

C. Composition of Solid Waste

1. Matter (4.0)

a. Metals

i. Ferrous
ii. Aluminum
iii. Copper
iv. Other

b. Paper

i. Kraft
ii. Newsprint
iii. Other

c. Rubber

d. Food

e. Glass

f. Plastic

g. Other

2. Energy (5.0)

a. Content

b. Accessibility/Usefullness

c. Theoretical Equivalence

3. Packaging (6.0)

III. Other Sources of Resources in Solid Waste

A. Matter (7.0)

1. Metals

a. U.S. Production

b. U.S. Known Reserves

c. Future U.S. Requirements

d. Production Energy Needs

2. Paper

a. U.S. Production

b. Forestry requirements

i. Trees
ii. Land
iii. Time

c. Future U.S. Needs

d. Production energy needs

3. Glass

a. Raw materials availability

b. Production energy needs

B. Energy (8.0)

1. Domestic Fuels

2. Foreign Fuels

IV. Non-Recovery Solid Waste Disposal Practice

A. Landfill (9.0)

1. Operation

2. Land requirements

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1. Operation

2. Land Requirements

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A. Source Separation

B. Industrial Separation

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2. Facilities under construction in Florida

3. Research

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1. Current Florida facilities

2. Current Florida facilities under construction

3. Research

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1. Production

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a. Materials

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OBJECTIVES
ACTIVITIES
FACT SHEETS

1.0 The student will be able to demonstrate an understanding of the concept of Resource Recovery by:

1.1 Defining Resource Recovery.

(Resource Recovery is: The extraction and use of materials and values from solid waste. Materials recovered include metals and minerals that can be used in the manufacture of new products. Recovery of values includes energy recovery by using components of waste as a fuel, production of compost using solid waste as a medium and reclamation of land through sanitary landfills. Any process in which matter or energy traditionally discarded is recovered for reuse.)

1.1.1 You are the local newscaster; conduct "on-the-street" interviews in your home and neighborhood asking what resource recovery is; present it to class on your daily news broadcast.

1.1.2 Call persons or companies in your community which deal with solid waste waste or scrap materials. Ask for their definitions of resource recovery. After listening to several opinions, formulate one or more clear definitions for class discussions. Class will have groups of four or five students each review their collections and come up with one or two favorites. Group spokesmen will present their choices to the class to be listed on blackboard for class discussion.

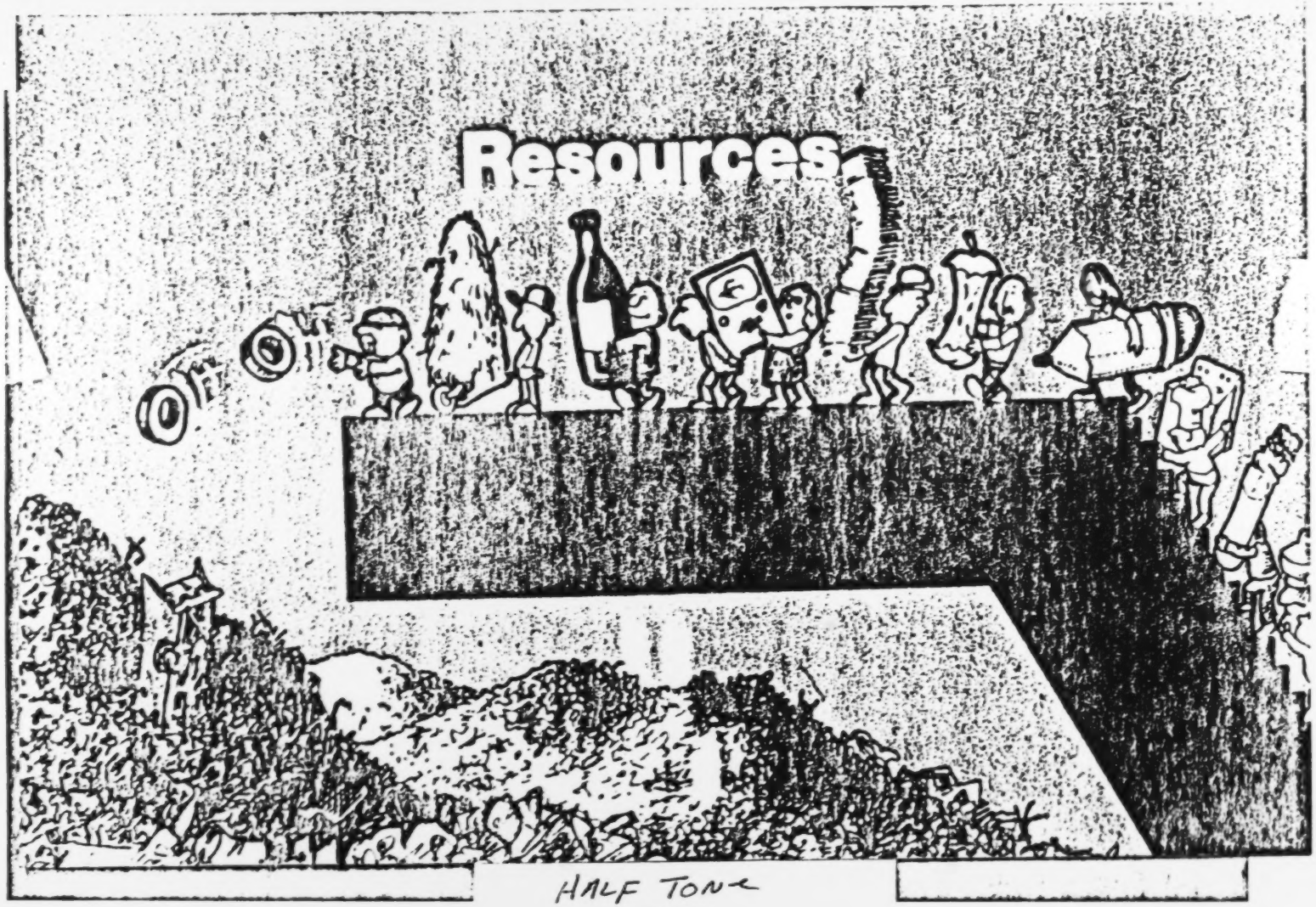
1.1.3 Go to the library and find three definitions of resource recovery. Bring each definition to class on a 3 x 5 card for display.

1.2 Describing the general purpose of Resource Recovery, or listing two main goals of Resource Recovery.

(To: gain as many valuable resources as possible; reduce solid waste to smallest dimension for final disposal.)

1.2.1 From your current understanding, describe the purpose or goal of resource recovery. Ask some public officials and business leaders to do the same. Summarize the answers and decide if resource recovery is just a fad or an important indication of a changing living style. Will resource recovery become more or less important as the years pass? Why?

1.2.2 List all of the organizations which can impact resource recovery programs. Find out what each organization is doing in this area.



HALF TONE
100%

SOLID WASTE

CALL IT trash and garbage . . . rubbish and refuse . . . discards and throwaways, solid waste is, more specifically, *the negative but necessary residuals from homes, businesses and institutions.* It is that which enters a local system for collection and disposal.

Some 136 million tons of it is generated annually in the U.S. This amounts to about 3½ pounds per person each day.

IT CONTAINS food wastes, leaves and lawn clippings . . . old newspapers, magazines and assorted papers . . . food and beverage cans and bottles . . . old clothes and wrappings . . . disposable cups, plates, razor blades and diapers . . . broken small appliances and busted toys . . . paint cans, cosmetic jars and tubes . . . rags, rugs, vacuum cleaner sweepings . . . and just plain dirt.

When disposed, this mingling of organic and inorganic matter typically breaks down to:

35% Paper	2% Textiles
16% Yard Wastes	4% Plastics
15% Food Wastes	3% Rubber and Leather
10% Metals	5% Miscellaneous
10% Glass	

Municipal waste composition varies according to the size and location of each community, type of neighborhood, time of year, and existing climatic conditions. Rural communities, for example, usually have more food and yard wastes, but less paper; and, metropolitan areas have a larger percentage of old newspapers. In late December, there is more packaging and wood (Christmas trees).

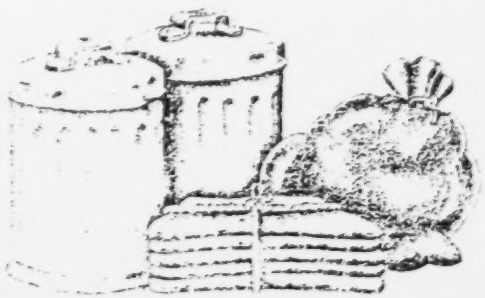
Regardless of its volume and content, it is the responsibility of each jurisdiction to handle these non-productive "negatives" in the most efficient, least costly and most environmentally sound manner possible.

THE PROBLEMS created by discarded solid waste are, basically, environmental and economic. Unless properly disposed of, it will pollute air, water and land. The most damaging environmental effects result from the ancient but, unfortunately, still prevalent practice of *open dumping.*

Approximately $4 billion are spent annually for collection and disposal of urban refuse.

Waste problems are most acute when there are large concentrations of people. It is also in these metropolitan centers that land is least available for the disposal of solid waste. In some cities where incineration has been a major form of waste disposal, stringent air quality standards are forcing either the addition of expensive pollution control devices, or the actual closing of the incinerators. And, the latter step results in an even greater demand for diminishing disposal sites.

IN THEORY, resource recovery represents a modern-day response to the waste disposal problems facing many communities.

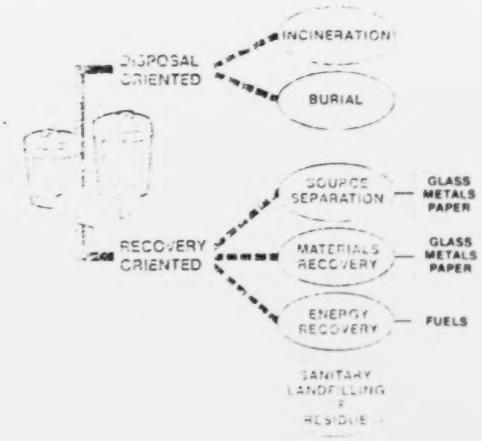


RESOURCE RECOVERY

IN PRACTICE, it provides for the recovery of large amounts of waste components, thereby eliminating the need for their disposal. As much as 85 percent of municipal "trash can" refuse would be diverted from the disposal process if the combustible materials were recovered for use, and if the metals, glass and some paper were extracted for recycling. The lifetime of a landfill would, therefore, be extended appreciably, and disposal costs stabilized or even reduced.

TO BE PRACTICAL for any community, a number of conditions must exist before resource recovery can be undertaken:

- the technical ability to separate particular components — materials and/or energy — in prescribed conditions to meet the specifications of buyers and users;
- the need, indeed demand, for the recovered products;
- positive benefits and opportunities — economic, environmental and management — for the various recovery project "partners." (These participants can include local and state governments, and such private sector firms as consulting, architectural and engineering companies . . . equipment manufacturers . . . builders and operators of recovery facilities . . . purchasers and users of recovered materials and energy.)



IN FACT, resource recovery is only now being applied simply because these conditions did not previously exist. Until recently, communities were able to dispose of their solid waste through forms of open dumping, the least costly method of disposal; and, they could burn their refuse in on-line incinerators, which did not meet air quality standards. Also, there was little concern for conservation of materials and energy resources and, consequently, no demand for the "reusables" in our waste.

THE AWARENESS, in the early 1970's, of the need for environmental preservation helped provide the incentive to search for more acceptable forms of disposal; e.g., sanitary landfilling and adequately filtered incineration. The concentration of waste, shortages of landfills and improved methods of disposal all result in increased disposal costs to the municipality. As these costs rise, resource recovery becomes a more attractive and economically competitive alternative to traditional forms of disposal.

There were two "external" occurrences that also stimulated the movement toward resource recovery: the search for new energy sources, combined with escalating costs for fossil fuels; and, the recognition of the need to conserve raw materials. For the first time, urban solid waste was being viewed as a potential reserve of recyclable materials . . . and a "tappable" source of energy.

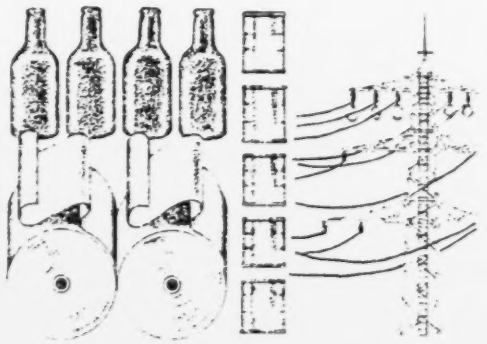
THE TYPE AND FORM of recovery to be pursued will depend on the needs, conditions and markets in each community. Following are brief descriptions of the three major forms of resource recovery being applied today.

Source Separation is the segregation and collection of recyclable solid waste materials before they become mixed in the trash can. Many voluntary and municipal programs are underway to collect bottles, cans, newspapers, corrugated containers and office papers.

Through demonstration grants from the U S Environmental Protection Agency, source separation programs in two Massachusetts communities were initiated to collect steel and aluminum cans, bottles and mixed papers for sale locally. In 1977, EPA awarded implementation grants to two California counties for separate collection programs, and two other communities in Minnesota and Idaho for implementation of recycling programs. Source separation programs are essentially "labor intensive," requiring citizen support and involvement, an effective management system and available local markets for the collected materials.

Materials Recovery is the industrial processing of mixed municipal waste to recover recyclable metals, glass and paper to acceptable specifications. A series of unit processes is usually incorporated within a system to sift, sort and separate the desired components. Such processes can include shredders, magnetic separators, air classifiers, screens, "aluminum magnets," heavy media separators, froth-flotation units and optical sorters.

Energy Recovery is the extraction and utilization of energy-generating products in solid waste. The target of various energy recovery approaches is the estimated 70 percent of combustible materials — primarily paper, light plastics and other organics — in urban refuse. Once separated and processed, this material becomes a low sulphur fuel comparable in energy value to some western coals.



Some of the "energy-from-refuse" products and processes are:

- *Refuse-Derived Fuel* (RDF) — the processed combustibles used as a direct supplement to coal or oil to produce electricity, heat and cooling;
- *Thermal Combustion* — the use of refuse as a fuel to produce steam;
- *Pyrolysis* — the conversion of waste combustibles to such other fuels as oil and gases by "baking" in an oxygen-starved environment;
- *Anaerobic Digestion* — the generation of methane gas by decomposing waste under controlled conditions.

EMERGING SYSTEMS for materials and/or energy recovery were, by late 1977, either operating, being constructed, contracted for, or had issued *requests for proposals* in the following jurisdictions:

Akron, Ohio
Albany, N Y
Ames, Iowa
Appleton, Wis
Auburn, Maine
Baltimore, Md
Baltimore County, Md
Beverly, Mass
Bridgeport, Conn
Central South Central Connecticut
Chicago, Ill
Contra Costa County, Calif
Dade County, Fla
Detroit, Mich
Duluth, Minn
East Bridgewater, Mass
Fairmont, Minn
Franklin, Ohio
Hampton, Va
Hempstead, N Y
Jefferson County, Ky
Knoxville, Tenn
Lane County, Ore
Milwaukee, Wis
Montgomery County, Ohio
Monroe County, N Y
Mountain View, Calif
Nashville, Tenn
Newark, N J
New Orleans, La
New York, N Y
Niagara Falls, N Y
North Hempstead, N Y
Palos Verdes, Calif
Pinellas County, Fla
Pompano Beach, Fla
St Paul, Minn
Salt Lake County, Utah
San Diego County, Calif
Saugus, Mass
Seattle, Wash
South Charleston, W Va
Tacoma, Wash
Tulsa, Okla
Wilmington, Del

Not included in this partial listing are the scores of communities magnetically separating ferrous metals or conducting source separation programs for old newspapers, cans, bottles, corrugated and office papers.

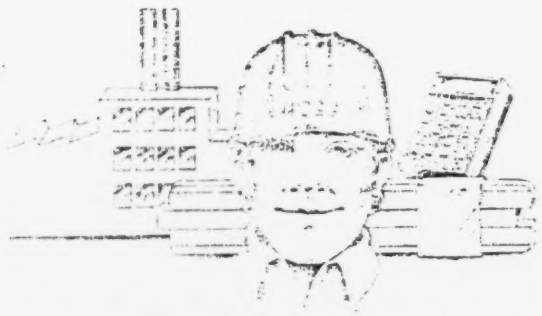
NCRR, INC.

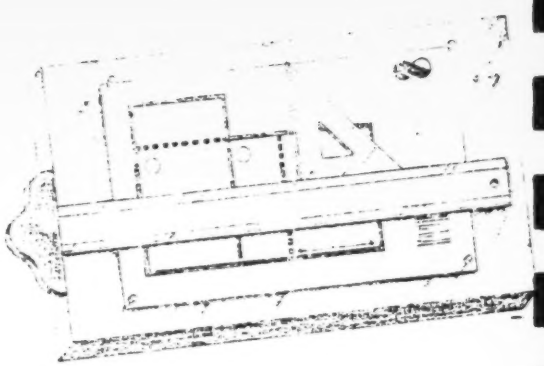
THE PRIME MISSION of the non-profit National Center for Resource Recovery is to help remedy solid waste disposal problems faced by jurisdictions across the country. Its activities are directed at stimulating the advancement of resource recovery, as a partial solution, through research and development.

A coalition of industries and labor unions formed the National Center in 1970, and continue to provide major funding support. The NCRR board of directors is comprised of senior executives from 17 industries and three labor unions. In addition, the board includes representatives from education and public interest communities.

The National Center for Resource Recovery Foundation was established as a separate corporation in 1972 for the purpose of providing funding support.

National Center efforts are concentrated on systematically studying recovery technology and approaches; working with private and public sector organizations and agencies; performing engineering and equipment research projects; conducting demonstration and technical assistance programs, and communicating qualified and objective information to all interested audiences.





MAJOR NCRR PROGRAMS include *implementation, test and evaluation, technical assistance, education, training* and *public awareness.*

Implementation of the first full-scope materials recovery facility is being completed in New Orleans, La. Named *Recovery 1,* it is designed to process some 650 tons of municipal refuse daily and separate for sale steel, aluminum, other nonferrous metals, glass and paper. Waste material not reclaimed will be disposed of in an environmentally acceptable landfill to recover previously unusable land for use as building property.

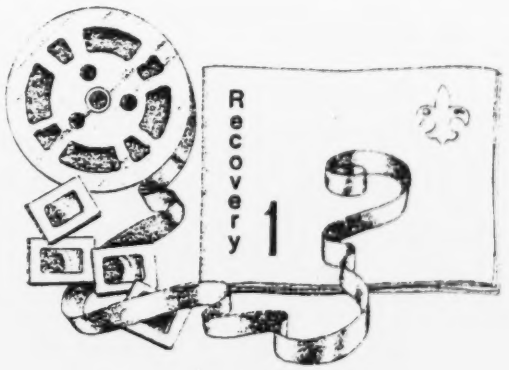
Startup of the Recovery 1 facility was in July 1976. Ferrous, aluminum and other nonferrous metals, and glass recovery began in late 1977, with paper recovery planned in the future.

The National Center worked with the City of New Orleans for four years in designing this innovative recovery/disposal system. The Center provides technical assistance to the City, $1 million in the form of a loan/grant to the private owner/operator — Waste Management, Inc. — and conducts associated research and evaluation projects. All technical and financial data gained from Recovery 1 operations will be made available to any interested municipality.

Test and Evaluation is performed primarily by NCRR at its *Equipment Test and Evaluation Facility* (ETEF) in Washington, D.C. This pilot plant is operated with the cooperation of the District of Columbia. Supporting these activities are the U.S. Environmental Protection Agency, Department of Energy and several firms and foundations.

At ETEF, a variety of materials and energy recovery units are being investigated. These include shredders, air classifiers, magnetic separators of ferrous metals, an eddy current or "aluminum magnet" separator, froth-flotation system of glass separation trommels and a densifier that extrudes air classified organic waste into pellets. This refuse-derived fuel can be used as a substitute or supplement to coal in stoker-fired energy boilers.

Technical Assistance is performed by NCRR under contract to a number of federal, state and local agencies. These projects include marketing surveys, resource recovery planning and feasibility studies. NCRR is also active in helping coordinate the development of specifications for recovered materials and energy.



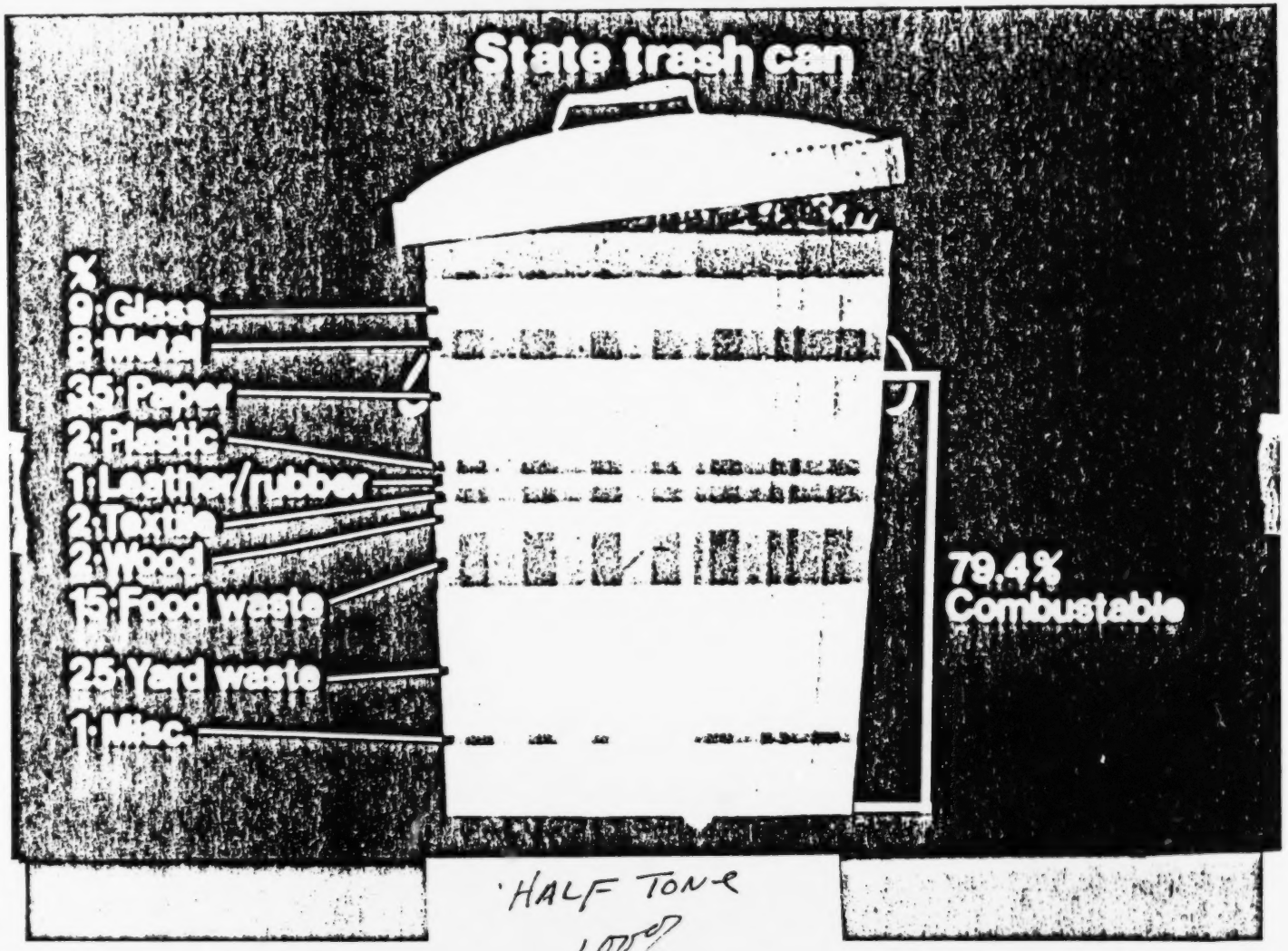
Education, or the dissemination of technical, institutional and economic information, is a primary and continuous mission of NCRR. The Center conducts seminars and conferences for local and area planners and decision makers, members of the business community, educators, and for general and public interest audiences.

Assistance has also been provided in developing curricula for college level engineering courses. A resource recovery kit of materials was authored for junior and senior high schools, and teacher workshops have been conducted. The National Science Foundation supported a series of intern programs for college faculty members.

Training includes a summer internship for college students; and a four-month program for professional staff members of municipal solid waste agencies, made possible by another foundation grant.

Public Awareness is an important element of the Center's education mission. Under this program, NCRR produces and distributes technical reports, semi-technical journals, periodicals and a variety of other material prepared for both technical and general audiences. These include the quarterly *NCRR Bulletin* . . . a weekly, five-minute public service radio series . . . a 20-minute feature film . . . four state-of-the-art textbooks . . . a multi-disciplinary education kit . . . a general purpose slide presentation . . . a monthly newsletter . . . and other special brochures and technical reports.

STATE OF FLORIDA



HALF TONE
100%

2.0 The student will demonstrate knowledge of the major types of solid waste by:

2.1 Identifying the six major types of solid waste.

(agricultural, industrial, municipal, construction debris, yard wastes, hazardous wastes)

2.1.2 Go to a nearby transfer station or landfill and observe the contents of solid waste. Can you classify the contents into major types? Can you think of solid wastes in your community which may not reach the landfill?

2.2 Describing or listing the characteristics of each major type of solid waste.

Agricultural (and food processing)
animal manure, plant stalks, hulls, leaves

Construction Debris from construction sites:
building materials, tree trunks and roots

Industrial wastes from industrial processes and manufacturing operations such as factories, processing plants, repair and cleaning establishments, refineries, and rendering plants

Municipal (household and commercial)
garbage and trash

Yard Wastes
grass clippings, prunings, weeds, brush

Hazardous Wastes
radioactive, pathogenic, munitions, oils, acids, solvents, other chemicals

2.2.1 Visit a crop farm, livestock farm, tree nursery, wholesale florist, orchard, or agricultural processing plant. Find out by questioning and observation what agricultural waste includes, how much of it there is, and what future uses it might be put to on the farm or by others who take it away. What are the seasonal variations?

2.2.2 Interview a general contractor or building demolition contractor. Find out what materials are left in a building when they knock it down. What size are the pieces when they are loaded into trucks; where do the trucks take them; how many truckloads does it take to haul away the pieces of a house, a gas station, a hotel or office building? Does brick building waste go somewhere different than wooden and steel building waste? Where does it go when it's all mixed together? What do they do with the big trees and roots? List the future uses that these materials might be useful for at the demolition site and by others who take them away.

2.2.3 Visit some industries and see what solid wastes are generated. How are the wastes handled and stored? Ask if the industry has a description of its solid waste composition or quantity. Can you think of uses for this material?

2.2.4 Talk with the driver of the truck who comes through the neighborhood picking up branches and palm fronds, or the maintenance man who prunes and cleans up yards, parks or playgrounds. What does he do with the waste material? Does it have any future uses that might benefit someone? Is there about the same amount every week, or does it vary? Why?

2.2.5 Visit a local hospital, a veterinarian, a copper refinery, an electroplating shop, a chemical plant, pest control service, and inquire if any of their waste materials can be called hazardous or toxic. Ask why they are toxic, to whom they are toxic, and how they are toxic: for humans to touch or breathe the air; for animals to eat or roll in; for fish in your streams; for birds to be exposed to? Find out if there might be some good that these wastes could be used for. Where does this hazardous or toxic waste ultimately end up?

2.3 Distinguishing between (or among) the six major types of solid waste in terms of their character..

2.3.1 Discuss the characteristics of each of the six major types of solid waste. Are they predominantly animal, plant, mineral, or chemical in nature? Which types are likely to be most alike? Least alike? Can you think of any solid wastes that could be placed into more than one group?

2.4 Describing how hazardous wastes differ from municipal wastes. Describe their composition and source.

2.4.1 Visit a local electroplating company, pest control service, or chemical plant and ask about their wastes. Are they primarily solid, liquids, or gases? Did the waste start out as a hazardous material? Compare this to your family's trash and garbage. Does it contain any hazardous wastes? What are they?

2.5 Thoroughly describing garbage as it is produced by households, restaurants, markets, and hotels.

Garbage - Rejected food wastes, including waste accumulation of animal, fruit, or vegetable matter used or intended for food or that attends the preparation, use, cooking, dealing in or storing of meat, fish, fowl, fruit, or vegetable.

2.5.1 Visit the supermarket and find out what is thrown away from each department. Does someone come by and pick up all the trimmed off meat fat and bones? What are they used for?

Does a farmer pick up all the scrap fruit and vegetables? What does the farmer do with this unsaleable food? What happens to dairy products and bread after their expiration dates? If damaged packaged goods are not sold, where do they go? When canned goods are removed from cardboard cartons and put on the shelves where does the carton go? What is it useful for?

2.5.2 Talk with the employees at your local hotel. What do they do with the food that people leave on their plates? What happens to the little cakes of soap that have only been used for one day?

2.5.3 Ask the man in the filling station what happens to the oil removed from a car when the oil is changed. What are some new uses for old oil? Is the old oil different from the new oil or is it just dirty?

2.5.4 Take an inventory of the types of materials in your family's solid waste collection for the week. Is there a lot of variety; classify the types as to glass, plastic, paper, cardboard and brown bags, metal, food, and rubber? How much of this is just packaging like wrappers, bags, bubble-paks, boxes, etc.? Look at the collection and list ways in which different materials could be used again.

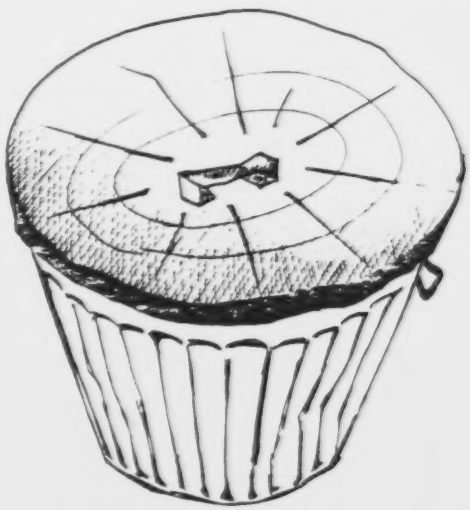
2.5.5 Set up four containers in your home and label them "paper," "food scraps," "metal," and "other." Record the weight of each empty container. Classify all of your household waste for two weeks. At the end of each week, weigh each container and determine the weight of each type of waste. Further classify the "paper" by newspaper waste and other paper products. Assuming the heating value of paper is 7,400 Btu/lb, food scraps is 3,000 Btu/lb, metal is 0 Btu/lb, and other waste is 10,000 Btu/lb, determine the heating value of each of the components and the heating value of the waste as a whole. Which component will supply the most heat? Read your electric meter for the same two weeks and find out how many kilowatt-hours of electricity your family used. Assuming that it takes 17,000 Btu of solid waste to produce one kilowatt-hour of electricity, figure out how much of your weekly electricity usage could be provided by burning your solid waste. What portion of your electricity could be supplied just by burning old newspapers?

The Anatomy of a Can

Typical Components in Solid Waste:

- *Brown paper*
- *Citric rinds & seeds*
- *Corrugated paper boxes*
- *Dirt*
- *Flower garden plants*
- *Fried fats*
- *Glass, ceramics & ash*
- *Grass clippings*
- *Leather goods*
- *Magazine paper*
- *Mail*
- *Meat scraps (cooked)*
- *Metals*
- *Newspaper*
- *Paper food cartons*
- *Paint & oils*
- *Plastic coated paper*
- *Plastics*
- *Rubber goods*
- *Shrub and tree trimmings*
- *Textiles*
- *Tissue paper*
- *Vacuum cleaner catch*
- *Vegetable food wastes*
- *Wax cartons*
- *Wood*

National Center for Resource Recovery, Inc.
1211 Connecticut Ave., N.W. Washington, D.C. 20036



National Center for
Resource Recovery, Inc.

What's in Our Trash and Garbage?

It's a good question; one that's too often overshadowed by the figures of quantity and cost.

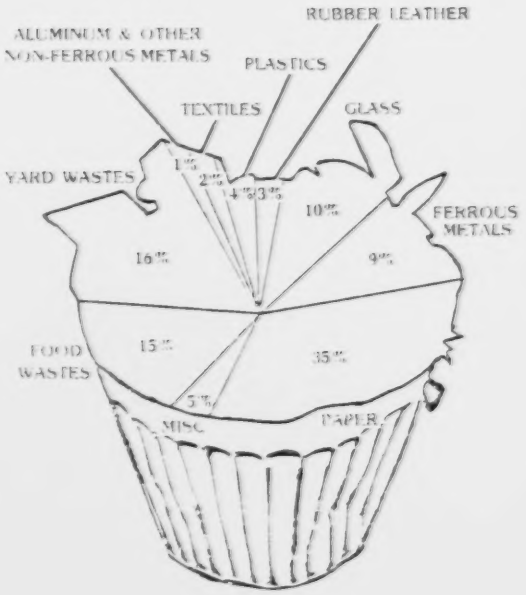
True, solid waste has increased to where some 136 million tons are generated annually in the U.S. And, it's expensive to handle. The cost of collecting and disposing of refuse now exceeds $4 billion each year.

A key to the recovery and reuse of components in our refuse, however, lies equally in its composition.

Glass, metals and paper, for example, can be recycled into new products, thereby saving both raw materials and energy. The combustible portion of solid waste—about 75 percent of the total amount generated—can be converted into energy through: *mass burning* to produce steam; *refuse-derived fuel* produced from processed refuse; *liquid* or *gaseous fuels* made by further processing waste.

Composition of Municipal Solid Waste

(by weight)



Source: EPA *Fourth Report to Congress*, 1977

OVERVIEW

- **Volume of solid waste**
  - Municipal solid waste (residential, commercial and institutional sources) amounted to about 130 million metric tons in 1976, enough to fill the New Orleans Superdome from floor to ceiling, twice a day, weekends and holidays included. Per capita generation amounts to 1,300 pounds a year. By 1985, the yearly total is projected to increase to 180 million tons.
  - Industrial waste generation is estimated at 344 million metric tons a year, with a growth rate of 3 percent per year. EPA estimates that 10-15 percent of industrial wastes will be classified as hazardous under the hazardous waste regulatory program.
  - Municipal wastewater treatment at 18,000 plants results in 5 million tons (dry weight) of sludge per year; the amount is expected to double in the next 8 to 10 years due to higher levels of treatment.
  - By 1985, flue gas cleaning equipment will be installed on 100,000 megawatts of power. Over 120 million metric tons of wet sludge will have to be disposed of annually, enough to cover an area of over 27 square kilometers (10 sq. mi) more than 2.7 meters (9 feet).
  - Agricultural wastes and mining wastes each amount to billions of tons yearly.

- **How the wastes are being managed**

  Municipal solid waste

  - About 227,000 people are employed in management of municipal solid waste, according to a 1973 study. About three-quarters of them are needed for collection of the waste. Slightly over half the work force is employed by private contractors, the rest by municipal and county agencies.
  - Direct costs of municipal solid waste collection and disposal are estimated to be $30 per ton, or over $4 billion a year in 1976.
  - Solid waste collection is a hazardous occupation; collection workers suffer injuries at 4 times the rate for all industry. Individual agencies report injury costs in excess of $1,000 per man-year.
  - Municipal solid waste is disposed of on 18,500 sites covering a total of 500,000 acres, according to the 1976 EPA report to Congress on the effects of waste disposal on ground water.

  Industrial and hazardous waste

  - Seventy to 80 percent of industrial waste is currently disposed of on the generator's property.
  - Surface impoundments for industrial waste total more than 100,000.

- There are approximately 100 commercial facilities available for disposal of hazardous waste; studies indicate that their current capacity may be only 50 percent utilized given the availability of "cheap" alternatives.
- Expenditures by industry for hazardous waste disposal is estimated at $155 million annually, according to EPA studies.

Municipal sludge

- About 25 percent of the municipal sludge generated is being landfilled, 25 percent is being spread on land surfaces (mainly agricultural land), 15 percent is disposed of in the ocean, and 35 percent is incinerated.
- Municipal sludge disposal sites on land total about 23,000.
- Costs of managing and disposing of municipal sludge are estimated to total $635 million annually.

- **Effects on health and the environment**
  - Among the various problems observed to result from inadequately managed disposal of waste on land, degradation of ground water is of greatest concern. Once polluted, an aquifer may not be usable as a drinking water source for decades. At present about half the U.S. population is served by ground water.
  - Numerous instances of ground-water contamination by leachate from waste disposal sites have been documented. For example, of 50 industrial waste sites evaluated by an EPA contractor in 1977, 43 showed migration of hazardous constituents into ground water.
  - Ground water contamination is the most common mechanism involved in documented cases of damage from hazardous waste disposal. Other major routes are: surface water contamination by runoff from disposal sites; air pollution via open burning, evaporation, sublimation, and wind erosion; poisoning through direct contact or via the food chain; and fire and explosions.
  - Up to 90 percent of industrial hazardous waste is being disposed of by the same methods that have produced the damages documented to date.
  - In addition to pollution of water and air, problems at municipal solid waste disposal sites have included gas explosions, breeding of rats and flies, odors, litter, and traffic congestion. These problems can be avoided or controlled in the siting, design, and operation of disposal facilities.
  - The spreading of municipal sludge on agricultural land, if uncontrolled, poses a threat to public health, plant growth, water quality, and wildlife.

HAZARDOUS WASTE MANAGEMENT

- **EPA philosophy for regulating hazardous waste**
  - Hazardous wastes include reactive, corrosive, ignitable, infectious, radioactive, and toxic wastes. (Specific criteria are now under development.)
  - The desired management options are (in order of desirability):

    Reduce the generation of hazardous waste
    Separate out and concentrate hazardous waste
    Utilize the waste
    Destroy in special incinerators or detoxify and neutralize
    Disposal in secure landfills

  - Hazardous waste must be regulated from creation through final disposal ("cradle to grave") to assure that all of it is safely managed.
  - Regulation will close off indiscriminate disposal and stimulate use and expansion of hazardous waste management facilities.

- **Generators of hazardous waste**
  - Major generators among the 15 industries EPA has studied in detail are:

(Million tons per year)

Primary metals	8.3	Textiles	1.8
Organic chemicals	6.7	Petroleum refining	1.8
Electroplating	5.3	Rubber and plastics	0.8
Inorganic chemicals	3.4	Mics. (7 sectors)	0.7
		Total	28.8

  - Ten States generate 65 percent of hazardous waste; these States are: Texas, Ohio, Pennsylvania, Louisiana, Michigan, Indiana, Illinois, Tennessee, West Virginia, and California.

- **Technology options and costs**
  - Environmentally adequate technology options are feasible for treatment and disposal of hazardous wastes; their costs are substantially above those of inadequate practices (open dumping). Costs vary according to type and volume of waste handled.

	Cost per ton
Secure chemical landfill	$30-55
Incineration (land-based)	75-265 (110 typical)
Landspreading	2-25 (6 typical)
Chemical fixation	10-30
Physical, chemical, biological treatment	Variable

- Increased waste management costs to industry as a result of the hazardous waste regulations may amount to $800 million a year, according to early EPA forecasts (current hazardous waste disposal costs is estimated at $155 million per year). The affected industries have gross annual sales of about $154 billion.

- **Federal regulatory program**

  - Seven sets of regulations and guidelines are being developed under Subtitle C, RCRA:

    Identification and listing of hazardous waste (Section 3001)
    Standards for generators (Section 3002)
    Standards for transporters (Section 3003)
    Standards for facilities (Section 3004)
    Permit regulations (Section 3005)
    Guidelines for States (Section 3006)
    Notification system (Section 3010)

  - Cradle-to-grave control via manifests and reporting is the keystone of the program: only permitted sites may receive hazardous wastes. EPA anticipates 25,000 permit applications nationally.

- **State hazardous waste programs**

  - EPA anticipates 30-35 States will apply and qualify for "interim authorization" to operate the program in lieu of EPA. Such authorization allows 2 years for upgrading the State program to standards for full authorization.

  - For "full authorization," State programs must be equivalent to the Federal program, consistent with other State and Federal programs, and provide for adequate enforcement.

  - EPA must operate the program in any State not gaining authorization.

  - State and Federal costs for implementing the program are expected to total about $20 million a year.

  - FY-79 grants to States specifically for hazardous waste program development are expected to total $15 million.

- **Public aversion to waste processing and disposal facilities—a key problem**

  - Local opposition to establishment of waste management facilities is a major obstacle not only for hazardous waste management but for solid waste management in general. Such opposition has often blocked siting that was desirable from environmental and economic viewpoints.

  - Several States and a number of localities have imposed bans and restrictions on the movement of waste into their jurisdictions. Restrictions on the movement of hazardous waste have caused especially difficult problems - many of the specialized facilities equipped to handle certain hazardous wastes must serve large areas in order to be economically viable.

  - Assurance of improved management of waste and incorporation of public education and participation measures should affect public attitudes, but whether they will reduce opposition enough to permit all the well-justified sitings that are needed is uncertain.

Agricultural Wastes from Field and Row Crops
(Tons per Acre per Year)

Crop	Waste Generation Rate
Asparagus	1.5
Barley	1.5
Beans	2.0
Broccoli	4.0
Brussels Sprouts	3.0
Cabbage	3.0
Cantaloupes	3.0
Carrots	2.0
Cauliflower	4.0
Celery	2.0
Cotton	2.0
Corn[a]	4.5
Cucumbers	2.0
Garlic	2.0
Lettuce	4.0
Melons	3.0
Milo	1.5
Oats	1.5
Onions	2.0
Peanuts	2.0
Peas	2.0
Peppers	2.0
Pineapple	10.92
Potatos	2.0
Rice	3.0
Safflower	1.5
Sorghum	3.0
Squash	3.0
Sugar Beets	3.0
Sugar Cane	19.2
Tomatoes	3.0
Wheat	1.5
Miscellaneous	2.0

[a]Field and sweet corn (not silage corn).

From: "Handbook of Solid Waste Management", edited by David Gordon Wilson, Van Nostrand Reinhold Company, 1977.

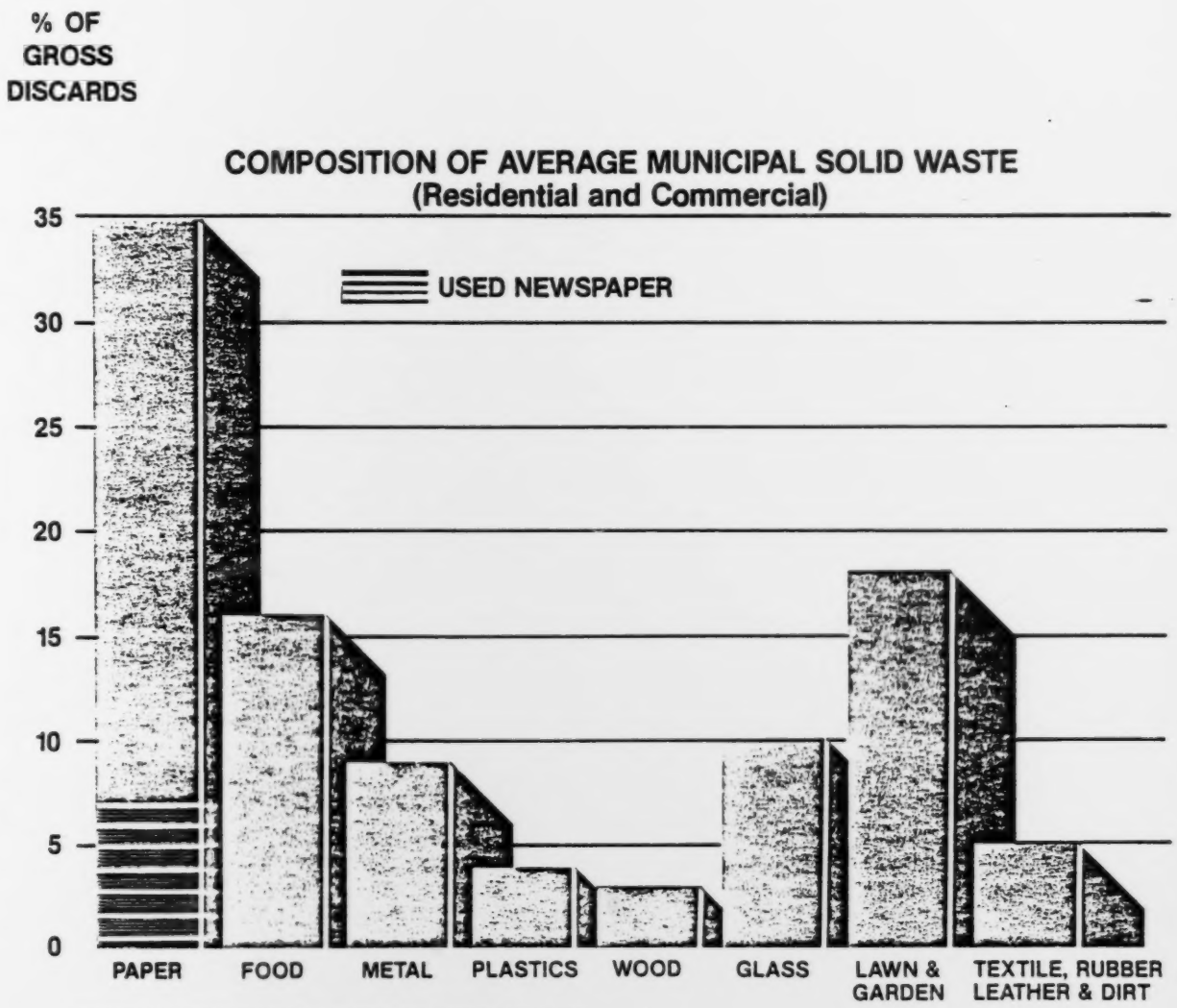
WASTE CLASSIFICATION UTILIZATION CHART	POTENTIAL HAZARDS				MANAGEMENT METHODS															
	Toxicity	Explosiveness/ Flammability	Pathogenicity	Radioactivity	Std. Storage	Spec. Storage	Std. Coll. Vehicle	Spec. Coll. Vehicle	Std. Pipeline	Spec. Pipeline	Compaction	Grinding	Pulping (w/H_2O)	Composting	Incineration	Incineration (Liquid)	Incineration (Spec.)	Chemical Treat. or Alteration	Sanitary Landfill	Ocean Disposal[3]
Solid wastes																				
Putrescible			x		x		x					x	x	x	x				x	
Bulky Combustible						x		x			x	x			x		x		x	
Bulky Non-Combustible						x		x			x	x							x	
Small Combustible					x		x				x	x	x	x	x				x	
Small Non-Combustible[1]					x		x				x	x							x	
Non-Empty Cans, Bottles, Drums[1]	x	x	x	x	x	x	x	x									x		x	
Gas Cylinders		x				x		x									x		x	
Powders and Dusts		x				x		x									x		x	
Pathological Wastes	x		x	x		x		x							x		x	x	x	
Sludges	x					x		x							x		x	x	x	x
Demolition and Construction						x		x				x					x		x	
Abandoned Vehicle						x		x			x	x					x		x	
Radiological Waste				x		x		x									x		x	x
Liquid wastes[4]																				
Waste Waters									x							x		x		
Contaminated Waters[2]	x			x		x		x	x	x						x		x		
Liquid Organics[2]	x		x			x		x	x	x						x		x		x
Tars	x	x				x		x	x	x						x	x	x		
Slurries[2]	x					x		x	x	x						x		x		x
Gaseous wastes[4]																				
Odorous	x	x				x		x									x	x		
Combustible Particulate		x				x		x									x	x		
Organic Vapors	x	x				x		x									x	x		
Acid Gases	x	x				x		x									x	x		

[1] For contents treatment see proper classification; this class for container only.

[2] Pipeline selection dependent upon specific contaminent.

[3] Ocean disposal as locally permitted or approved - not recommended procedure.

[4] Final disposal of these wastes requires an initial transformation to the solid class (except as noted).



SOURCE: U.S. ENVIRONMENTAL PROTECTION AGENCY, MAY 1978

3.0 The student will demonstrate a knowledge and understanding of the factors affecting generation of solid waste by:

3.1 Discussing the change in the amount of yard waste due to geographic location and season of year.

3.1.1 Make up a chart showing how many times you mow your yard in each month of the year. Weight the clippings from the next time you mow your yard. Figure out how many pounds of clippings you dispose of each month. Use different lengths of adding machine tape to make a display that shows the monthly variation in the number of pounds of yard clippings disposed of. Do you see any changes from month to month?

3.2 Quantifying the local generation of solid waste.

3.2.1 Ask your County's solid waste administrator how much solid waste is generated in your community each year. Find out how much solid waste has been generated each year for the past ten years. Using the adding machine tape, prepare a chart showing the amount of solid waste generated each year.

3.2.2 Collect and weigh the solid waste generated by your entire class for a period of two weeks. What is the average amount generated by each person? What materials make up most of the waste? How does your school dispose of this solid waste? Could it be reused?

3.3 Quantifying the per person generation of solid waste in your community.

3.3.1 Call your local Chamber of Commerce, or planning agency, and find out your community's population each year for the past ten years. Determine the average mount of solid waste generated per year by each person in your community. Using adding machine tape, prepare a chart showing this for each year. Do the numbers show an overall trend toward an increasing or decreasing amount of solid waste? What do you think the amount of waste per person will be next year?

3.4 Discussing annual solid waste generation by average city dweller and the annual increase.

3.4.1 Using the charts prepared above, determine the percentage change in the per person solid waste amount from each year to the next. Prepare another chart showing these percentage changes. Is the percentage change per year getting larger or smaller. Discuss reasons for the changes. Do you think the trend shown by your chart will continue? Why, or why not? How have changes in life style affected the trend? Do you see evidence of our society becoming a "throw-away" one?

3.5 Discussing changes in municipal solid waste composition because of changes in living habits.

3.5.1 For each of the following items, ask your parents how much they disposed of ten years ago compared with how much they dispose of today; disposable soft drink bottles, returnable soft drink bottles, aluminum cans, plastic food wrap, aluminum foil, plastic milk cartons. Make up a chart for each one showing the comparison. Prepare a similar chart for each item comparing today's usage with what you think it will be ten years from now. Compare charts with your classmates and discuss the reasons for your estimates. Discuss the reasons for the difference in estimates among your classmates.

3.6 Explaining the difference between municipal and industrial solid waste generation.

3.6.1 Look back through the types of solid waste with an eye toward the volume of, say glass, that is discarded in Florida. Prepare a chart showing: the proportions of glass in each type of waste, the quantities of glass in each type of waste. Draw a pie chart of all glass waste with differing sized pieces for types of waste.

PAPER STOCK: A VITAL RECYCLED RESOURCE

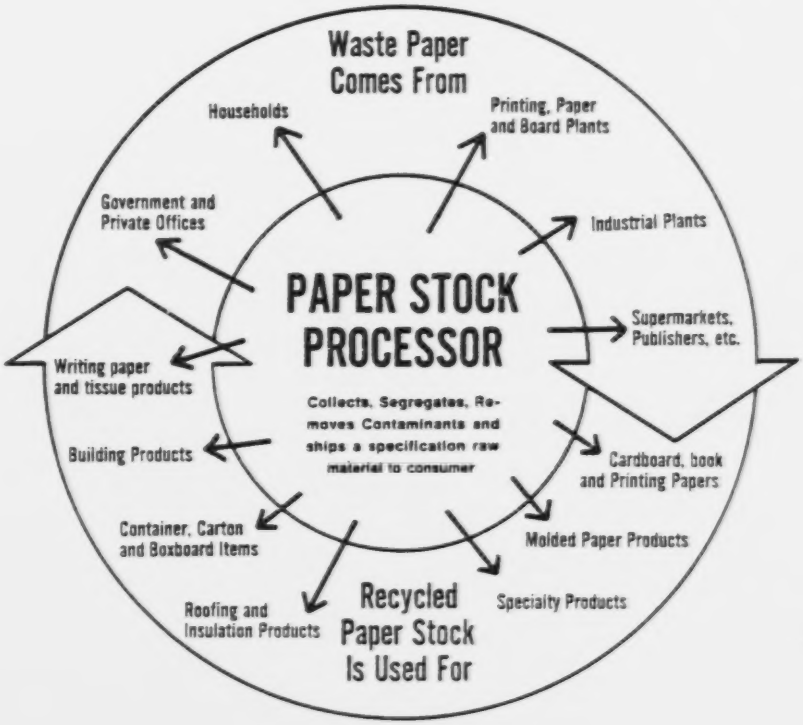
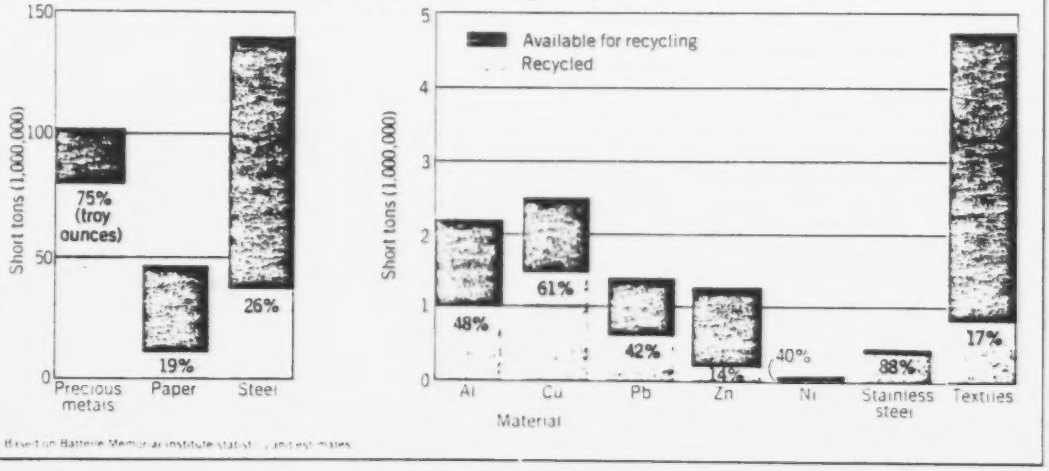

Waste Paper Comes From
Households
Printing, Paper and Board Plants
Government and Private Offices
Industrial Plants
PAPER STOCK PROCESSOR
Collects, Segregates, Removes Contaminants and ships a specification raw material to consumer
Supermarkets, Publishers, etc.
Writing paper and tissue products
Building Products
Cardboard, book and Printing Papers
Container, Carton and Boxboard Items
Molded Paper Products
Roofing and Insulation Products
Recycled Paper Stock Is Used For
Specialty Products

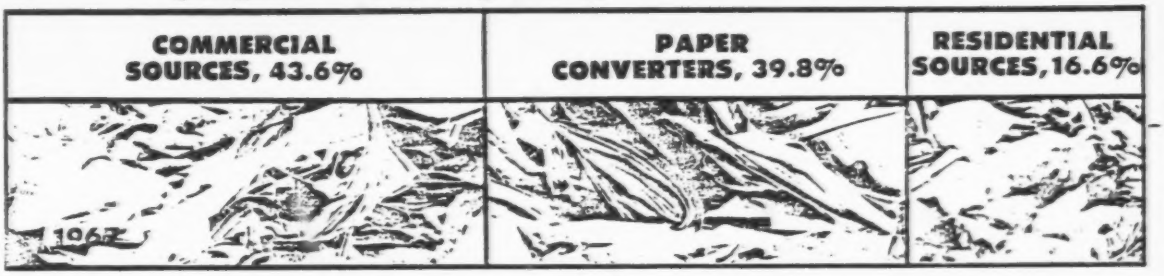
Figure 1

Recoverable material resources currently recycled

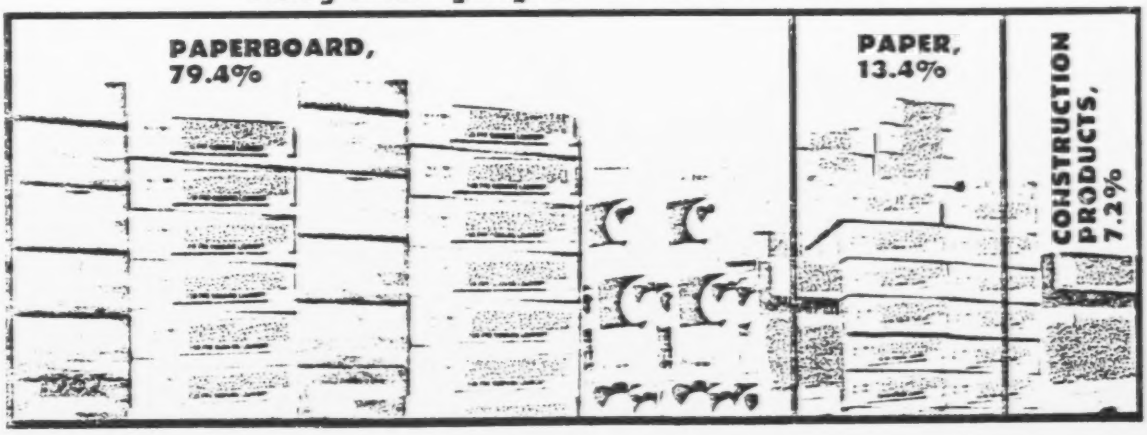


Based on Battelle Memorial Institute statistics and estimates

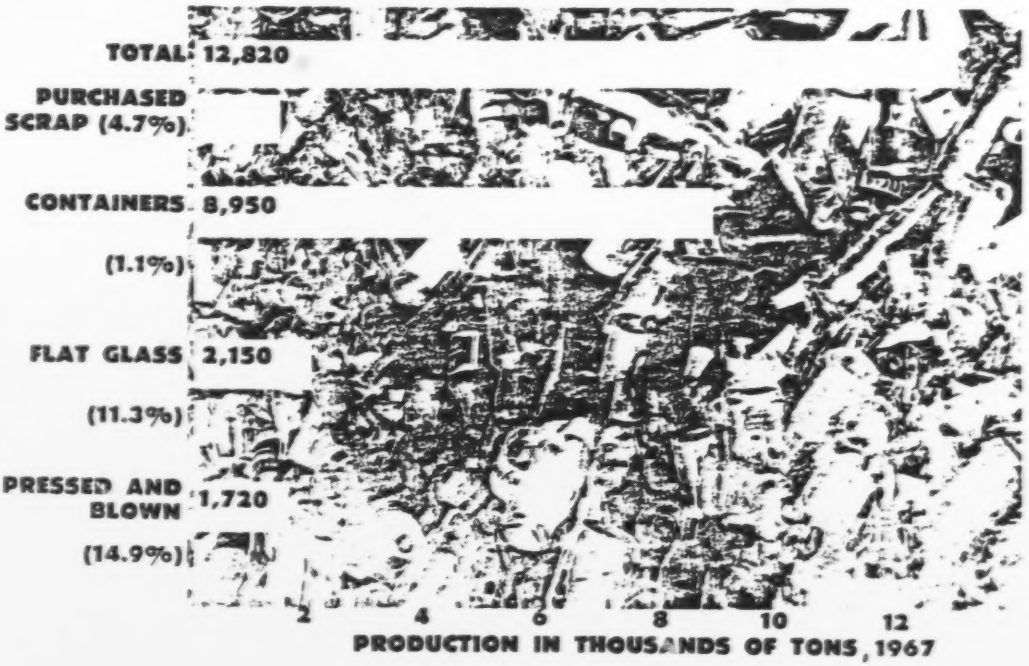
paper for recycling comes from . . .



recycled paper is used in . . .



purchased scrap glass represents less than 5 percent of production



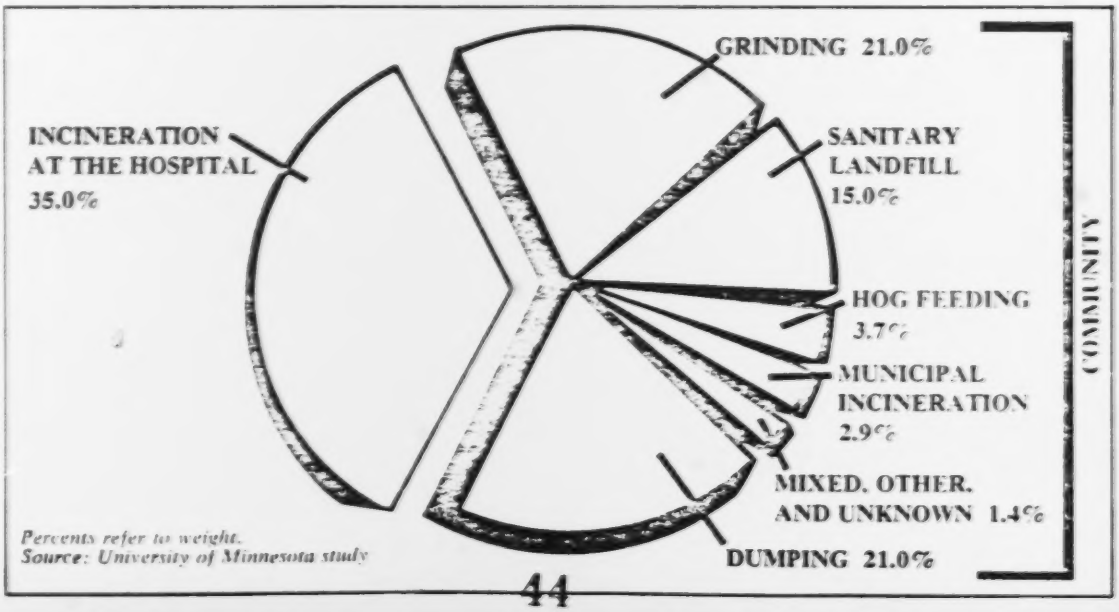
estimating waste

Generated by Individual Units of West Virginia Medical Center

HOSPITAL FACILITY	EXPECTED POUNDS PER DAY ARE EQUAL TO:
HEAVY-CARE UNITS:	
General surgery, neurosurgery, cardiovascular, urology, eye, chest, burns, maternity-newborn, orthopedics, operating room, intensive care, recovery	**4.47 times** the total number of paid staff* for that unit, excluding doctors
LIGHT-CARE UNITS:	
Metabolic, psychiatric, general medicine, pediatrics, gynecology, neurology, ear-nose-throat	**2.77 times** the total number of paid staff* for that unit, excluding doctors
SUPPORT UNITS:	
Administrative offices, gift shop, dietary offices, laundry, pharmacy, receiving, regional medical program, Appalachian Respiratory Diseases Lab	**2.21 times** the total number of paid staff* for that unit, excluding supervisors or administrators
SPECIAL UNITS:	
X-ray, radiation therapy, emergency room, central supply	**0.48 times** the number of patients treated or orders filled
Clinical laboratories, outpatient clinic	**0.19 times** the number of tests run or patients treated
Kitchen, cafeteria	**1.5 times** the number of patient meals served

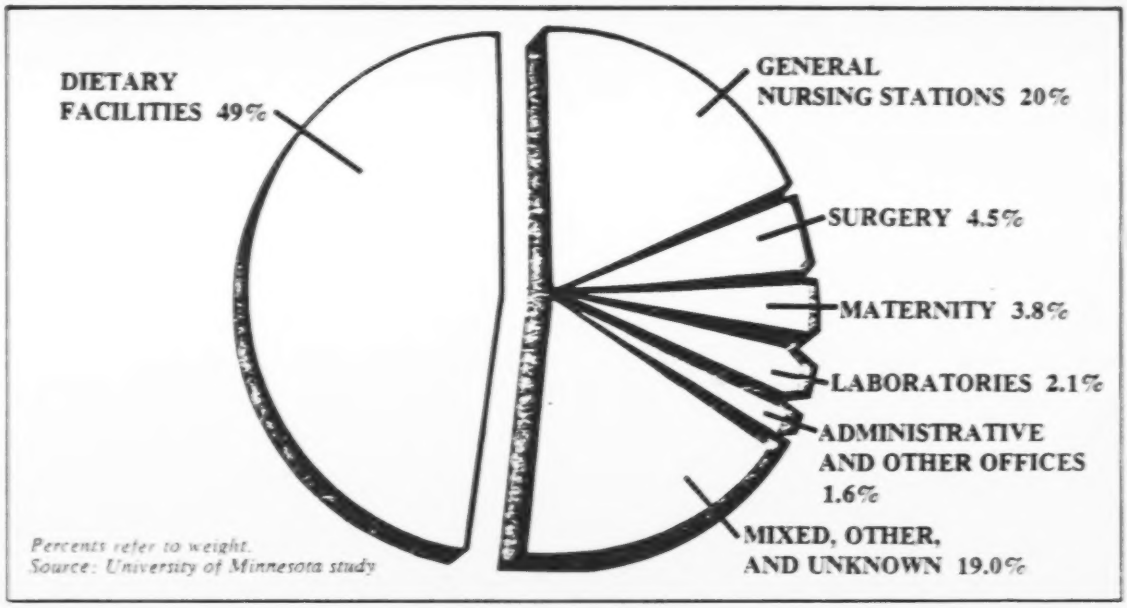
** Registered nurses, licensed practical nurses, practical nurses, nurses' aides, orderlies, laboratory assistants, technicians, graduate assistants, secretaries, station clerks, cashiers, office support personnel, janitors, maids, housekeepers, floor sweepers, maintenance men, laborers, etc. Source: West Virginia University study*

most hospital wastes go outside the hospital

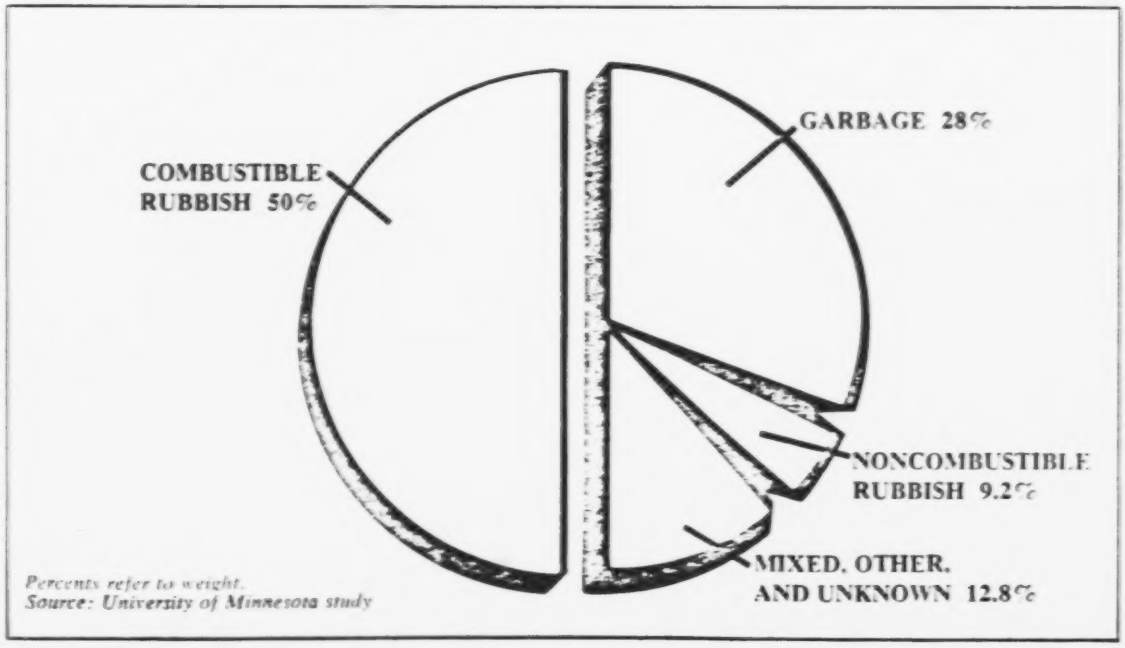


Percents refer to weight.
Source: University of Minnesota study

dietary facilities account for half of hospital wastes



half of hospital waste is combustible



Data on the Generation, Storage, and On-Site Disposal of Hospital Waste.[17]

Hospital	No. of beds	Average patient load	Disposal of H.W.[a]	Disposal of garbage	Disposal of gen. refuse	Freq. of coll. (gen. refuse/wk)	Incin. residue (lb/day)	Gen. refuse lb/day	Total s/w lb/day/bed	Total s/w lb/day/ patient
A	152	117	Incin.[b]	Ground to sewer	Portable containers	12		1,980	13.02	16.9
B	250	250	Incin.[b]	Ground to sewer	Portable containers	6		2,060	8.25	8.25
C	406	330	Incin.	Ground to sewer	Port. cont. and incin.	6	413	1,880	7.17	8.82
D	367	312	Incin.	Ground to sewer	Port. cont. and incin.	6	224	555	3.95	4.65
E	236	156	Incin.	Fed to hogs	Incin. and port. cont.	6	228	912	3.87	5.85
F	85	69	Incin.	Ground to sewer	Port. cont. and incin.	4	300	56	10.23	12.6
G	1100	1045	Incin.[b] and port. cont.	Ground to sewer	Port. cont. and compactor	6		12,390	11.25	11.85
H	523	450	Incin.	Ground to sewer	Incin. and port. cont.	2	680	960	8.81	10.42
I	335	300	Incin.	Ground to sewer	Incin. and port. cont.	6	320	840	6.44	7.20
J	447	375	Compac.	Ground to sewer	Port. cont.	2		4,077	9.12	10.87
K	80	50	Compac.	Ground to sewer	Port. cont.	3		1,370	15.62	25.00
L	396	322	Incin. and port. cont.	Ground to sewer	Incin. and port. cont.	6	285	2,591	10.13	12.47

[a] Hazardous waste
[b] Pathological waste only.

Note: Pathological waste and garbage are not included in the total refuse (pounds per patient per day) due to their insignificant effect on overall generation of solid waste.

4.0 The student will demonstrate knowledge and understanding of the composition of solid waste matter by:

4.1 Categorizing all its characteristic forms into six or seven major material categories.

4.1.1 Prepare a presentation to the class on metals, paper, rubber, or other single category of waste material. Attempt to divide your category into as many separate parts as appear to be important in resource recovery. For each part, find a relative proportion to the entire category. List the main generators of this waste. List the main areas of potential purchase and reuse of scrap materials. In what form might they be purchased? Where in the state is there a market or use for these used materials? Prepare a map showing these market areas. What happens to these materials if they are not reused? What percentage of these waste materials are reused?

4.2 Describing or listing in detail the composition of municipal refuse or solid waste.

Solid Wastes = Refuse

Putrescible (capable of being rapidly decomposed by micro-organisms to give off nuisance odors and gases - kitchen wastes, garbage, offal, deal animals) and Nonputrescible - solid wastes except body wastes. Includes rubbish (paper, cardboard, tin cans, yard clippings, wood, glass, bedding, crockery, or litter of any kind), ashes, incinerator residue, street cleanings and solid market and industrial wastes.

4.2.1 Ask the administrator of your County's solid waste program for some information about the composition of wastes. How much do they dispose of each day? Each year? Does this administrator have information on the contents of solid waste from residential areas, stores, or industrial areas? You have several local industries that you could visit or perhaps telephone. Tell them you are interested in the types of solid waste materials that they have left over. Do they reuse some of these materials, sell some, or just have it hauled away? What materials in what quantity and in what form: big chunks or blocks, or little scraps or shavings? Get as much detail as you can for discussion with the class.

4.3 Describing a simple process to evaluate the present composition by weight of the typical categories of materials in your municipal solid waste.

4.3.1 Make an exhibit to display in class to show relative quantities of solid waste of the different types in your community, county, or state. Use different lengths of adding machine

tape to show total quantity; then color sections of the tape to show, for example, paper glass, etc. Put materials in the same order and with the same color on each tape to graphically show quantity relationships of solid waste from industrial, municipal, etc., sources.

4.4 Further separating metals and papers into common recovery categories.

4.4.1 Visit a scrap dealer or user to understand their needs and concerns relative to resource recovery. Learn what physical form scrap materials should be in for reuse. What are the quantities of scrap in relation to new materials used in their operation? Calculate the quantities of these materials available in your community. What quantities of scrap materials in your community find their way to scrap dealers and users? Would they use more scrap if it became available?

4.5 Describing differences between combustible and noncombustible objects in terms of: the articles, their volume, and normal disposal methods.

4.5.1 Visit a nearby landfill and classify the contents as either combustible or noncombustible. Note articles of the same of similar nature (i.e., wood, paper metal, rubber, plastic) and their physical size. How are these articles disposed of? Visit a junk automobile dealer. Ask him how he disposes of the cars. How does he dispose of the seats and interior? The tires? The engine? What parts of the cars are combustible?

4.5.2 Prepare a poster illustrating one of the following:

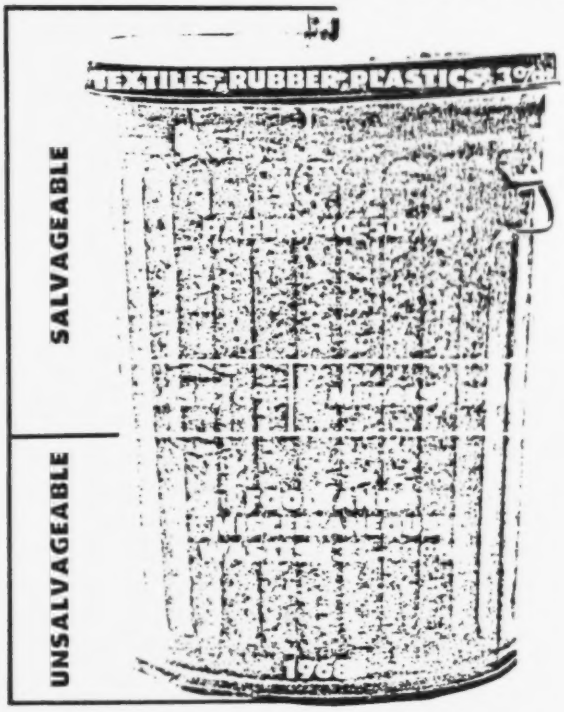
U.S. volume of solid waste in 1979 would fill three rows of garbage trucks side by side from the east coast to the west coast.

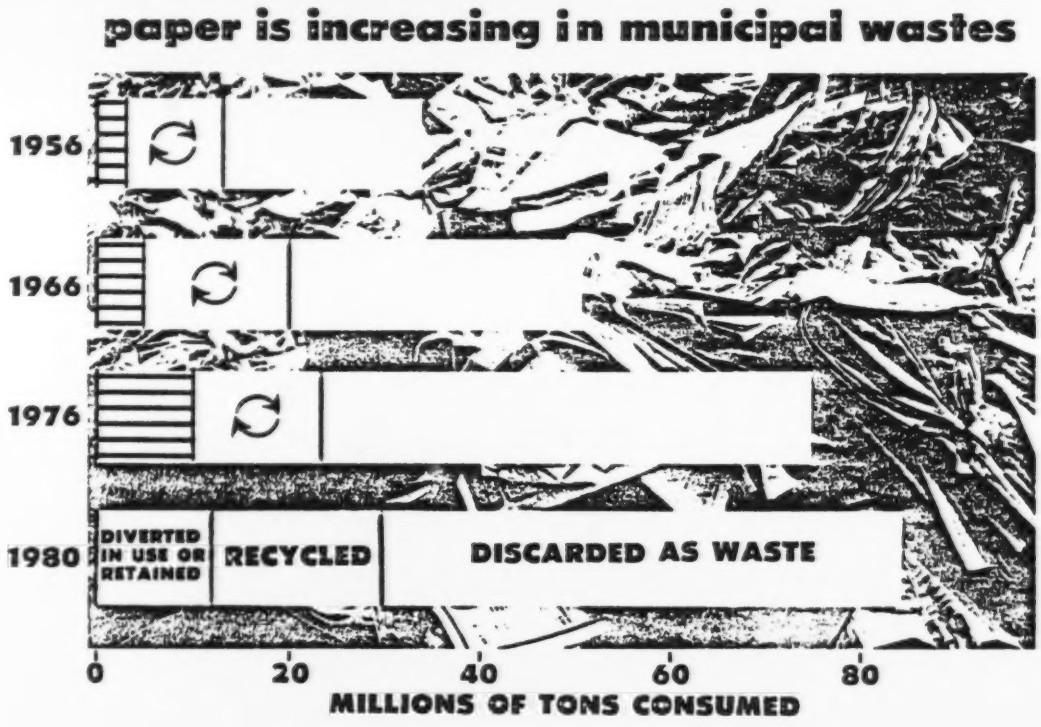
Solid waste generated in Florida during the 1980's would cover every interstate roadway in Florida to a depth of four feet.

a quarter of major manufactured materials are salvaged

Material (1967-68)	Total consumption (million tons)	Total recycled (million tons)	Recycling as percent of consumption
PAPER	53.110	10.124	19.0
IRON AND STEEL	105.900	33.100	31.2
ALUMINUM	4.009	.733	18.3
COPPER	2.913	1.447	49.7
LEAD	1.261	.625	49.6
ZINC	1.592	.201	12.6
GLASS	12.820	.600	4.2
TEXTILES	5.672	.246	4.3
RUBBER	3.943	1.032	26.2
TOTAL	191.220	48.108	25.2

over half of municipal wastes consist of salvageable commodities




paper is increasing in municipal wastes
1956
1966
1976
1980
DIVERTED IN USE OR RETAINED
RECYCLED
DISCARDED AS WASTE
0
20
40
60
80
MILLIONS OF TONS CONSUMED

Major Waste Categories

Acetylene Wastes
Agricultural Wastes
Aluminum
Animal-Product Residues
Antimony
Asbestos
Ash, Cinders, Flue Dust, Fly Ash
Asphalt
Bagasse
Bauxite Residue
Beryllium
Bismuth
Brass
Brewing, Distilling, Fermenting Wastes
Brick Plant Waste
Bronze
Cadmium
Calcium
Carbides
Carbonaceous Shales
Chemical Wastes
Chromium
Cinders
Coal
Cobalt
Coffee
Coke-Oven Gas
Copper
Cotton
Dairy Wastes
Diamond Grinding Wheel Dust
Distilling Wastes
Electroplating Residues
Fermenting Wastes
Fish
Flue Dust
Fluorine
Fly Ash
Food-Processing Wastes
Foundry Wastes
Fruit Wastes
Furniture
Germanium
Glass
Glass Wool
Gypsum
Hemp
Hydrogen Fluoride
Inorganic Residues
Iron
Lead
Leather Fabricating and Tannery Wastes
Leaves
Lime
Magnesium
Manganese
Mica
Mineral Wool
Molasses
Molybdenum
Municipal Wastes
Nonferrous Scrap
Nuts
Nylon
Organic Wastes
Paint
Paper
Petroleum Residues
Photographic Paper
Pickle Liquor
Plastic
Poppy
Pottery Wastes
Precious Metals
Pulp and Paper
Pyrite Cinders and Tailings
Refractory
Refrigerators
Rice
Rubber
Sal Skimmings
Sand
Seafood
Shingles
Sisal
Slag
Sodium
Starch
Stone Spalls
Sugar Beets
Sugar Cane
Sulfur
Tantalum
Tetraethyllead
Textiles
Tin
Titanium
Tobacco
Tungsten
Uranium
Vanadium
Vegetable Wastes
Wastepaper
Wood Wastes
Wool
Yttrium
Zinc
Zircaloy
Zirconium

General, Physical, and Chemical Parameters of Possible Significance in the Characterization of Solid Wastes.

GENERAL PARAMETERS

Compositional Weight Fractions

A. Domestic, commercial and institutional
   - Paper
   - Food waste
   - Textiles
   - Glass and other ceramics
   - Plastics
   - Rubber
   - Leather
   - Metals
   - Wood (limbs, sawdust)
   - Bricks, stones, dirt, ashes

B. Other municipal
   - Dead animals
   - Street sweepings
   - Catch-basin cleanings

C. Agricultural
   - Field
   - Processing
   - Animal raising

D. Industrial

E. Mining/metallurgical

F. Special
   - Radioactive
   - Munitions, etc.
   - Pathogenic
   - Moisture

Process Weight Fractions

Combustible
Compostable
Processable by landfill
Salvageable
Having intrinsic value

PHYSICAL PARAMETERS

Total Wastes

Size
Shape
Volume
Weight
Density
Density stratification
Surface area
Compaction
Compactability
Temperature
Color
Odor
Age
Radioactivity
Physical state
- total solids
- liquid
- gas

(Continued)

Solid Wastes

Soluble (%)
Suspendable (%)
Combustible (%)
Volatile (%)
Ash (%)
  soluble (%)
  suspendable (%)
Hardness

Particle Characteristics

Size distribution
  "shape"
  "surface"
  "porosity"
  "sorption"
  "density"
  "aggregation"

Liquid Wastes

Turbidity
Color
Taste
Odor
Temperature
Viscosity data
  specific gravity
  stratification
Effect of temperature
Total solids (%)
  soluble (%)
  suspended (%)
  settable (%)
Dissolved oxygen
Vapor pressure
Effect of shear
  rate
Gel formation

Gaseous Wastes

Temperature
Pressure
Volume
Density
Particulate (%)
Liquid (%)

CHEMICAL PARAMETERS

General

pH
Alkalinity
Hardness ($CaCO_3$)
MBAS (methylene-blue-active substances)
BOD (biochemical oxygen demand)
COD (chemical oxygen demand)
Rate of availability of nitrogen
Rate of availability of phosphorus
Crude fiber
Organic (%)

(Continued)

General (Continued)

Combustion parameters
- heat content
- oxygen requirement
- flame temperature
- combustion products (including ash)
- flash point
- ash-fusion characterization
- pyrolysis characterization

Toxicity
Corrosivity
Explosivity
Other safety factors
Biological stability
Attractiveness to vermin

Inorganic and Elemental

Moisture content
Carbon
Hydrogen
(P_2O_5 and phosphate)
Sulfur content
Alkali metals
Alkaline-earth metals
Precious metals
Heavy metals
- especially mercury
- lead
- cadmium
- copper
- nickel

Toxic materials
- chromium
- especially arsenic
- selenium
- beryllium
- asbestos

Eutrophic materials
- nitrogen
- potassium
- phosphorus

Organic

Soluble (%)
Protein nitrogen
Phosphorus
Lipids
Starches
Sugars
Hemicelluloses
Lignins
Phenols
Benzene oil
ASB (alkyl benzene sulfonate)
CCE (carbon chloroform extract)
PCB (polychlorinated biphenyls)
PNH (polynuclear hydrocarbons)
Vitamins (e.g., B-12)
Insecticides (e.g., Heptochlor, DDT, Dieldrin, etc.)

From: "Handbook of Solid Waste Management", edited by David Gordon Wilson, Van Nostrand Reinhold Company, 1977.

Composition of a Scrapped Automobile Body

A. Components of sheared, unburned automobile scrap.

Component	Weight %	Est. % iron
Thin metal (1/8 in.)	58.9	97.0
Thick metal (1/8 in.)	20.8	99.0
Dirt and glass	10.8	21.0
Stainless Steel	0.3	74.0
Nonferrous metals	1.3	-
Combustibles	7.9	80.2

B. Recoverable metallic values in composite automobiles.

Component	Weight (lb)
#2 bundle iron	2,614
Cast iron	429.3
Copper	
Radiator stock	15.4
#2 heavy and wire	13.8
Yellow-brass solids	2.7
Zinc, die castings	54.2
Aluminum, cast, etc.	50.6
Lead	
Battery	20.0
Battery-cable clamps	0.4
Total	3,200.4

From: "Handbook of Solid Waste Management", edited by David Gordon Wilson, Van Nostrand Reinhold Company, 1977.

Primary Constituents of Cagegories of Mixed Municipal Refuse

Category	Description
Glass	Bottles (primarily)
Metal	Cans, wire, and foil
Paper	Various types, some with fillers
Plastics	Polyvinyl chloride, polyethylene, styrene, etc., as found in packaging, housewares furniture, toys, and nonwoven synthetic fabrics
Leather, rubber	Shoes, tires, toys, etc.
Textiles	Cellulosic, protein, woven synthetics
Wood	Wooden packaging, furniture, logs, twigs
Food wastes	Garbage
Miscellaneous	Inorganic ash, stones, dust
Yard wastes	Grass, brush, shrub trimmings

From: "Handbook of Solid Waste Management", edited by David Gordon Wilson, Van Nostrand Reinhold Company, 1977.

TYPICAL MATERIALS RECOVERED FROM SOLID WASTE
AND POSSIBLE MARKET OUTLETS

MATERIALS	USES	MARKET OUTLETS*
Paper Products		
Old Newspapers	Newsprint, Paperboard, Insulation, Construction Board, Clipboard	Paper stock dealers, Brokers and Paper Mills, Insulation Manufacturers
Corrugated	Corrugated materials, Kraftpaper, Linerboard, Construction Board	Paper stock dealers, Brokers and Paper Mills
Mixed Paper	Construc-Board, Clipboard	Paper stock dealers, Brokers and Paper Mills
Metals		
Aluminum Cans	Can stock, Aluminum	Metal processors, Brokers and Aluminum smelters
Steel Cans (with or without aluminum lids)	Iron and Steel Products	Metal processors, Brokers and Steel Mills
Iron and Steel Scrap	Iron and Steel Products	Metal processors, Brokers and Steel Mills
Mixed Nonferrous Metals (copper, lead, zinc, etc.)	Nonferrous Metals	Metal processors, Brokers and Smelters
Glass		
Color-sorted Glass	Glass Products	Glass dealers, Brokers and Glass Manufacturers
Mixed Glass	Glass Products	Glass dealers, Brokers and Glass Manufacturers

*Depending upon demand

5.0 The student will demonstrate knowledge and understanding of the energy component of solid waste by:

5.1 Defining energy.

(the ability or potential to do work.)

5.1.1 Prepare a poster showing the major sources and uses of energy in Florida.

5.2 Explaining what is meant by the phrase, "The energy potential of refuse."

5.2.1 Prepare a chart showing the percentage of energy content of solid waste by major component (i.e., wood, paper, plastic, metal). On the same chart show the percentage by weight of each major component. Which component contributes most of the weight to solid waste? Which contributes the most energy value?

5.3 Recalling the energy equivalent, in barrels of imported crude oil, of one ton of municipal solid waste.

5.3.1 Prepare a visual aid for presentation to class showing the equivalents of tons of solid waste generated in your community, the number of households this waste as a fuel could provide electricity for, and the barrels of imported crude oil required for the same task.

5.4 Describing how energy can be created (it cannot be created), converted (it can be converted into other forms), or destroyed (it cannot be destroyed).

5.4.1 Visit a local utility power plant. Ask the superintendent how much energy is contained in the fuel burned in one day and how much electrical energy this produces. Is all of the heat energy in the fuel converted into electrical energy? What percentage of the fuel energy was <u>not</u> converted to electrical energy? What happened to this energy? Does the utility use this "wasted" energy? Can you think of ways it could be used?

5.5 Defining a British Thermal Unit (Btu).

(The heat energy required to raise the temperature of one pound of water one degree Fahrenheit, from 60^{o} to 61^{o}.)

5.6 Defining heat.

(The energy a substance contains because of the total mass and motion of its atoms or molecules.)

5.6.1 Prepare a chart showing why substances change state as heat is added (i.e., from a solid to a liquid to a gas).

5.7 Giving an explanatory example of the statement: "Heat is a form of energy; when energy is used, heat is given off."

5.8 Calculating value of thermal equivalents of Btu's to barrels of oil.

5.8.1 Crude oil supplies about 50 percent of the energy used in the United States. About 50 percent of the crude oil is imported. Assume the United States currently imports 22 million barrels of oil per day. How many millions of Btu's of heat energy does this represent?

5.9 Calculating the Btu's released when burning solid waste.

5.9.1 About 0.5 ton of solid waste has the equivalent energy content of 1 barrel of crude oil. If the United States imports 22 million barrels of oil per day, how much solid waste would have to be burned to obtain the energy equivalent of this oil?

5.10 Determining the efficiency of burning municipal solid waste to produce steam, in relation to burning high grade coal, given the Btu equivalents. (Heat energy of coal: high grade anthracite @ 14,400 Btu/lb; bituminous coal @ 9,700 - 15,000 Btu/lb.)

5.10.1 One pound of solid waste has a heat content of about 4,500 Btu's. How many tons of solid waste must be burned to obtain the same energy output as burning one ton of high grade anthracite coal and one ton of bituminous coal. Prepare a chart that illustrates this.

5.10.3 Investigate the power source for electricity in your community; determining the type and source of fuel used. Florida disposes eight million tons of solid waste each year, while importing one half of its energy. Based on your investigations, make some assumptions to the class about why we import so much of our energy in Florida, and how much we could reduce the importation by producing energy from solid waste.

5.11 Distinguishing between direct and indirect use of steam.

(Direct: provide central heat; indirect: drive turbines that produce electricity.)

5.11.1 Prepare a chart listing some advantages and disadvantages of direct and indirect use of steam.

5.12 Explaining the term "heat of combustion" or "heating value" in terms of Btu.

(Heat of Combustion: the amount of heat, usually expressed as Btu per pound of as-fired or dry waste, liberated by combustion at a reference temperature of 68 degrees F. With reference to auxiliary gas, it is expressed as Btu per standard cubic foot, and to auxiliary oil as Btu per pound or gallon. Also called "heating value.")

5.12.1 Prepare a chart showing how many units (tons, cubic feet, barrels, etc.) of each of the following is required in order to provide the same heating value of one ton of solid waste (4,500 Btu/lb).

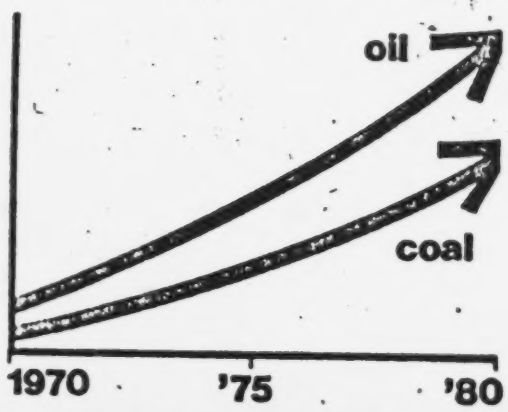
Gasoline	-	5,250,000 Btu/barrel
Fuel Oil	-	5,825,000 Btu/barrel
Natural Gas	-	1,100 Btu/cubic foot
Jet Fuel	-	5,600,000 Btu/barrel
Crude Oil	-	5,800,000 Btu/barrel

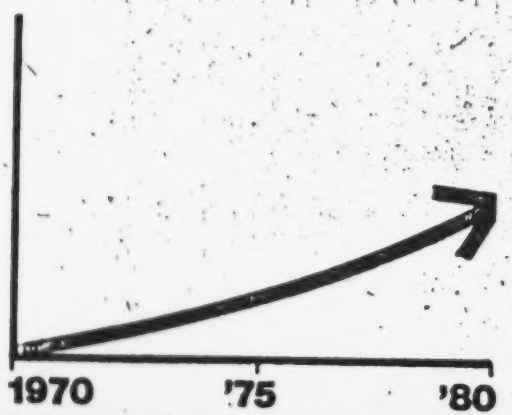
5.13 Developing estimates of your community's thermal energy:

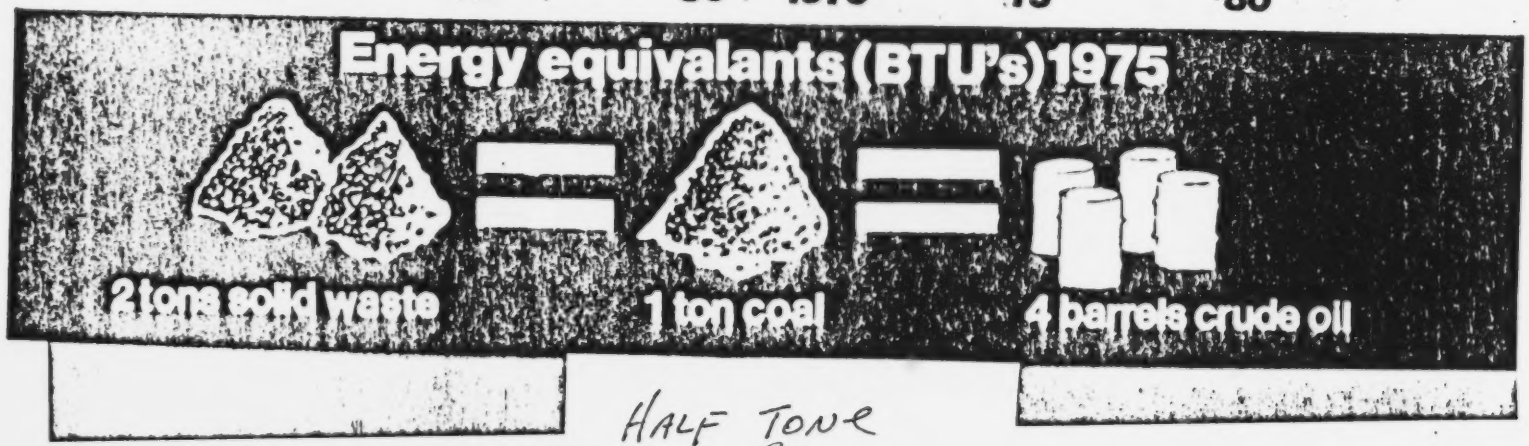
Use
Need
Waste
Recovery Potential

5.13.1 Call your local electrical utility and ask how many kilowatt-hours of electricity your community used last year. Find out how much fuel was used to generate that electricity. How much fuel was required to generate one kilowatt-hour of electric energy? A typical power plant is about 33 percent efficient. This means that for each Btu of heat energy burned as fuel, only about 1/3 of a Btu is produced as electrical energy. Find out what happened to the other 2/3 Btu. Prepare a chart listing some of the uses for the waste heat from a power plant.

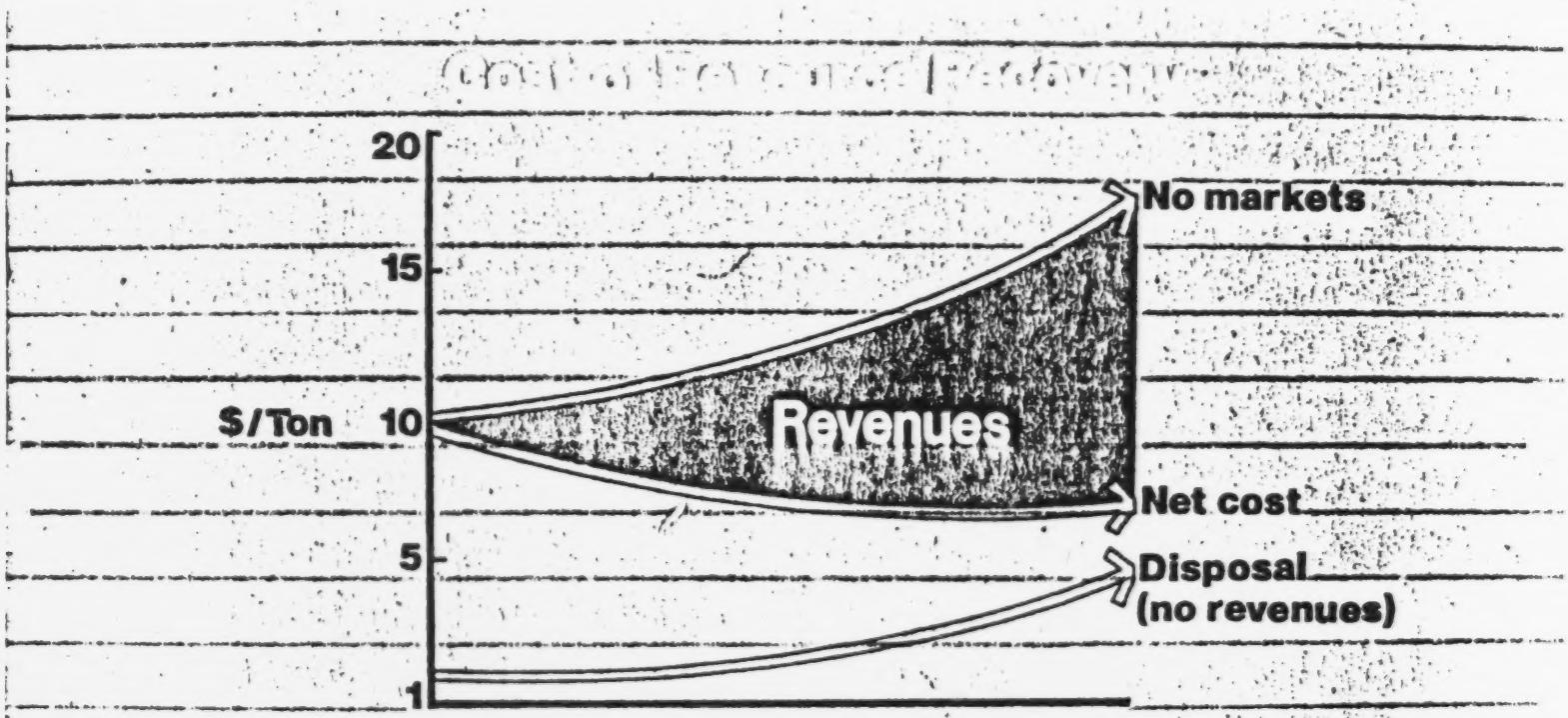
Rising







HALF TONE
100%


20
15
$/Ton 10
5
1
No markets
Revenues
Net cost
Disposal
(no revenues)

Cost
Revenues

HALF TONE

fact sheet -5.0

NATIONAL CENTER FOR RESOURCE RECOVERY, INC.

1211 CONNECTICUT AVE., N.W., WASHINGTON, D.C. 20036 (202/223-6154)

RESOURCE Briefs RECOVERY

July 1979

CONVERSION OF MUNICIPAL SOLID WASTE TO ENERGY

Following are excerpts from remarks made by Dr. Harvey Alter, NCRR director of research programs, before a joint hearing of the Subcommittee on Energy Development and Applications of the Committee on Science and Technology and the Subcommittee on Transportation and Commerce of the Committee on Interstate and Foreign Commerce, U.S. House of Representatives, on July 18, 1979.

Mr. Chairman and Members of the Committees:

In spite of recent progress, municipal solid waste (MSW) is a virtually untapped resource, both as a conserver of energy and as a source of fuel. The fuel should be considered for new boiler installations, and can be a low-sulfur supplement to coal in many existing installations. There are also future opportunities for using the waste as a source of fuel gas. Most of the opportunities are here today.

The resource recovery processing of MSW can provide an additional source of raw materials for industries for the remanufacture of paper, steel, aluminum and glass. Today, some post-consumer wastes are used as a raw material, particularly paper of several grades. The use of recovered paper, steel, aluminum and glass saves energy compared to using existing sources of virgin materials. The amount of municipal waste (exclusive of recovered paper) estimated to be in the Standard Metropolitan Statistical Areas (SMSAs) today could provide enough material to save the country 0.4 quad of energy per year. And, the combustible portion of this waste used as fuel could provide the U.S. with nearly 0.9 quad per year. (For thermodynamic reasons, energy savings of this sort should not be expressed as barrels of oil equivalent. However, bowing to popular practice, 0.4 quad is equivalent to approximately 60 million barrels of oil and 0.9 quad is approximately 136 million barrels.)

Municipal solid waste can be used as-received to generate steam and electricity in a device called a waterwall incinerator. Alternatively, the waste can be mechanically processed by a number of schemes to produce a shredded product for use either by itself or as a supplementary fuel with coal, to generate steam. (Perhaps by one scheme, it can be processed to a form called Eco-Fuel® for use with oil in some instances.) The major advantages of processing waste are to enable convenient storage and transport of the new fuel, and to produce daily a specification commodity of constant properties that meets the handling and burning requirements of the boiler.

There is healthy competition among purveyors of various waterwall incinerator designs and of mechanical processing systems. A disadvantage of the competition is present confusion over which system is "best," if indeed such a judgment can be made. The bases for picking a system are initially simple: they are cost and compatibility of the fuel with the intended boiler. For example, if the fuel is to be stored, mixed

and burned with stoker coal, the waste has to be mechanically processed and densified into pellets or other forms to resemble the lump coal used in stoker-fired units.

The development of resource recovery technology, and its consequent cost, have suffered from an initial zeal and lack of R&D. Initially, there was an insufficient technical base for a new industry. The result was that after design, construction, and operation, plans did not meet ordinary industrial objectives for reliability and low maintenance. Also, the materials and fuel products did not always meet specification; consequently, they could not be sold on a consistent basis. As a result, municipalities and industry are now hesitant to invest. Emphasis today is, therefore, on planning--and more planning--rather than on doing.

This overview of available waste-to-energy technologies will hopefully clarify what has been learned from past experiences and how future plants can be improved.

First, waste-to-energy technologies may be divided into what is available now and what is likely to be available sometime in the future. Available now are several methods for processing MSW to solid fuels, broadly termed refuse-derived fuel (RDF). As will be seen, there are several forms of RDF.

Likely to be available in the future are the technologies for biologically digesting MSW to produce methane and pyrolysis (chemical decomposition) to produce a mixture of combustible gases or liquids, or both.

Waste can be burned, as-received and without processing, in a waterwall incinerator. Such installations now in operation are generally copies from similar plants extant in Europe and elsewhere. Plant capital and operating costs are high because this is probably the only industrial application for a non-specification fuel. The plant has to accept waste of a wide range of properties, or that which is discarded as MSW. An advantage might be that the European experiences can be used to extrapolate costs. The technology is generally considered proven, if only because there are many replicate plants.

Waste can be shredded, the magnetic metals removed and the remainder burned, which is the approach used in plants under construction in Albany, N.Y., and operating in Hamilton, Ontario. This relatively inexpensive approach passes a great deal of noncombustible matter through the firebox.

An alternative has been to air classify, or winnow, the waste to remove some of the noncombustible material. The resulting fuel still contains a large fraction of noncombustible material; nonetheless, it can be burned by itself (as in Akron, Ohio, or Niagara Falls, N.Y.) or with coal (as in Ames, Iowa; Milwaukee, Wisc.; Chicago, Ill.; or Monroe County, N.Y.). When burned with coal, the fuel is shredded a second time to reduce the particle size.

In all of the above examples, the waste is shredded and classified dry. In some instances (Hempstead, N.Y., and Dade County, Fla.), shredding and classification are done in a water suspension and the fuel is squeezed to remove most of the water. (The plant in Hempstead is operating and the one in Dade County is under construction.

Various processes differ in detail but broadly, not in principle. When possible, implementors seek to co-fire the RDF with coal in a utility boiler because such boilers are generally large enough to accept all of the RDF a community could produce and obviously, resource recovery costs less using an existing boiler. However, there is no technical reason why a purpose-built boiler could not be used to provide steam or electricity, or both, from RDF.

There have been proposals, and some test firings, to use forms of RDF for other than raising steam. Particular proposals have been to use RDF in cement manufacture, aggregate drying and as a fuel for the incineration of sewage sludge (termed co-disposal). The first industrial application will be a plant for co-disposal soon to begin operation in Duluth, Minn.

Fuel users have objected to the high ash (or noncombustible) content of most RDF, and a few installations (Milwaukee and Ames) have retrofitted screens to sieve the RDF at some stage of processing to remove ash. In a different approach, one plant sieves the shredded waste (Madison, Wisc.) as part of producing RDF and two plants (New Orleans, La., and Bridgeport, Conn.) sieve the as-received waste to remove noncombustible material before the first shredding step. This latter approach is reported to be extremely effective in producing a low ash fuel.

Future plants should include some type of screening step in the process flow so as to narrow the range of fuel properties and thus improve the quality of the product sold Screening is relatively cheap and effective; some day screens may supplant air classifiers. However, more R&D is needed so as to be able to choose one type of screen over another.

The knowledge is available to overcome many of the recognized inadequacies of waste-to-energy plants. Generally, these plants have a poor reputation--sometimes deservedly--but given the chance, the plants can be greatly improved. New ones promise to be much more reliable. The reason waste-to-energy plants have a poor reputation is perhaps because unlike some technologies, resource recovery has not matured through a process of research, pilot plant, semi-works, etc. Rather, it began, and continues, as an art. As a result, technical problems and questions constantly arise, plants do not work as well as they might, and implementors find their investment insufficient to meet technical, sales and cost objectives. Importantly, profitability is not high enough for the private sector to invest large sums in R&D. Several government agencies notably the Bureau of Mines, EPA, and DOE, have established R&D programs; but at present, the DOE program is the only one essentially functioning.

The DOE program is directed mostly at solving operational and design problems identified in existing plants. It will, however, be a long time before the results of this research can be incorporated into new or existing plants. In the meantime, implementors perceive technical and economic risks and are fearful that the plant they build will not work, and that they will not be able to sell the recovered materials and energy products on a consistent basis. Apparently, implementors are waiting until such risks either disappear or are greatly lessened. In the meantime, few new plants are being built and resources are being buried.

There have been many proposals of programs to alleviate this situation, such as guaranteed loans and construction of demonstration plants. Clearly, we need more plants, incorporating the new designs based on what has been learned from operating the old. *The art cannot advance if there are no new trials, no experimentation, no new facilities.*

At present, implementors of new plants are generally reluctant to incorporate innovation. Understandably, a municipality must be prudent and thus seeks the "proven" technology of processes which are in operation elsewhere. Government support of innovation and R&D is viewed as a federal role, not state or local. Local governments would be hesitant today to invest in a process which merely placed a screen in a different location than as in present plants, or to accept a new kind of screen or other device which maybe has great promise but has not yet been used in resource recovery. A way must be found to encourage what might be termed "prudent innovation" in order to advance the art of resource recovery.

This brief technological overview hopefully communicated that the state-of-the-art today permits construction and operation of waste-to-energy plants. The question at hand is, what can be done to build more and better plants?

First, there is need for more R&D. Then, steps should be taken to reduce some of the risk currently impeding decisions for resource recovery. In the latter case, there have been proposals for guaranteed loans and demonstration grants. Though considered, little has been done.

The time has come to offer some new proposals to address the risks perceived by resource recovery plant owners and fuel users. The owners are concerned if the plant will work to specification and the users are concerned whether the new form of fuel will damage or otherwise interfere with the efficient use of their boilers (or other recovered materials interfere with their production processes).

The owners' concerns can be alleviated by a program which, after review of plans prior to construction, provides a fund (perhaps a maximum percentage of total capital cost), which will be available for repairs and retrofits after construction and start up, to correct operating deficiencies. After some period of time, operating shortcomings (such as failure of equipment to recover to specification) can be documented and identified and a plan formulated and costed to change equipment, or whatever else is needed, to make the plant fully operable. During the periods of problem identification and correction, the fund may also supplement the revenue shortfall from selling non-specification products at a discount. This feature will encourage continued operation of the plant, even if sub-optimal.

Fuel users are concerned about the long-term effects on their equipment from the new fuel. This may be alleviated by the establishment of a new form of boiler insurance against the extra and unknown risk of premature failure due to the new fuel. Because private carriers could not now estimate the risk, the government may have to participate in the underwriting, so as to bring the premiums within the range of normal types of business or boiler insurance premiums. This program could well be applied to either existing or new plants, so as to expand energy conservation and take greater advantage of existing plant facilities.

New programs of these types are likely to encourage the construction of many new waste-to-energy plants because the owners will be assured that ultimately their plants will work economically and their customers will be assured that the new fuels (or other products) will not cause them large maintenance bills at some future date. In this way, the current state-of-the-art of resource recovery can advance and the nation can achieve greater energy conservation and environmental benefit from what is now a waste. The technology is available today to make a significant start. We now need the will.

6.0 The student will demonstrate knowledge of packaging, as an important component of solid waste, by:

6.1 Describing its characteristics.

6.1.1 Investigate your household waste paper to get a clear picture of what might be included in the category of packaging. Mount a representative sample of the waste packaging on a display board for presentation to class. Of all the mountains of waste paper we discard daily, packaging accounts for more than half, 56 to 57 percent of waste paper; and about 13 percent of all collected refuse when you include plastic packaging. Present your thoughts to the class on packaging, in relation to energy and environment.

6.2 Estimating its quantity in relation to total municipal solid waste. (Around 25% (U.S. Totals: 1966-52 million tons, 1976-74 million tons))

6.2.1 Set up two containers at your house. Label one "packaging waste" and the other "other waste." Separate your household wastes for two to three weeks. In the container labeled "packaging waste" place all wastes that were used to wrap or hold something in, such as milk cartons, the plastic that meat and fresh vegetables from the grocery store come in, and boxes that items are packaged in. Also be sure to include tin cans, catsup bottles, and non-returnable drink bottles. Weigh each container at the end of each week. How much of your total waste is packaging waste? Compare your figures with those of your classmates. Make a poster listing some of your ideas on how the amount of packaging waste could be reduced. Discuss each one in class.

6.3 Formulating a realistic method of reducing its entrance into the stream of municipal solid waste.

6.3.1 Visit or phone interview a manufacturer of plastic goods used in packaging. Prepare an investigative report on the potentials and feasibility of reclaiming waste plastics, such as polyethylene, polystyrene, polyetheylene foam, rigid or plasticized PVC, or polypropylene film. Find out if manufacturers are mixing "home scrap" with virgin materials. Include your opinions on how one might improve the resource recovery process.

7.0 The student will demonstrate a knowledge of other sources of the materials found in solid waste by:

7.1 Describing our metal resources in terms of:

U. S. production
U. S. known reserves
Future U.S. needs
Energy needs for current production
Energy needs for future production

7.1.1 Investigate the following subjects at your local library or at your community college, regarding sources of metals:

U. S. production
U. S. known reserves
Future U.S. requirements
Energy needs for production from different sources, i.e., virgin ore, solid waste

Summarize your findings in the form of a graph or chart for presentation to class.

7.1.2 Find out how much of each type of metal is recycled today. How much could be recycled? Call or visit a local metal processing plant. Ask how much of his product is from recycled metal. Could he use more recycled metal? What is keeping him from using more recycled metal? Think of some ways we could help in recycling more of our metal products.

7.2 Describing our paper resources in terms of:

U.S. production
Forestry requirements: trees, land, time
Future U.S. needs
Energy needs for current production
Energy needs for future production

7.2.1 Visit a paper producer or mill and see what you can learn for the class regarding the source of materials for paper production in the U.S. Find out what the paper industry requires of the forests in terms of trees, land, and time. Learn what you can of what our future needs will be for paper production and the related energy requirements for the production process.

7.2.2 Find out how much of a tree it takes to product a Sunday edition of your local newspaper. How much energy does it take to produce the paper your Sunday edition is printed on?

7.3 Describing our glass resources in terms of:

U.S. production
Raw Materials availability
Future U.S. needs
Energy needs for current production
Energy needs for future production

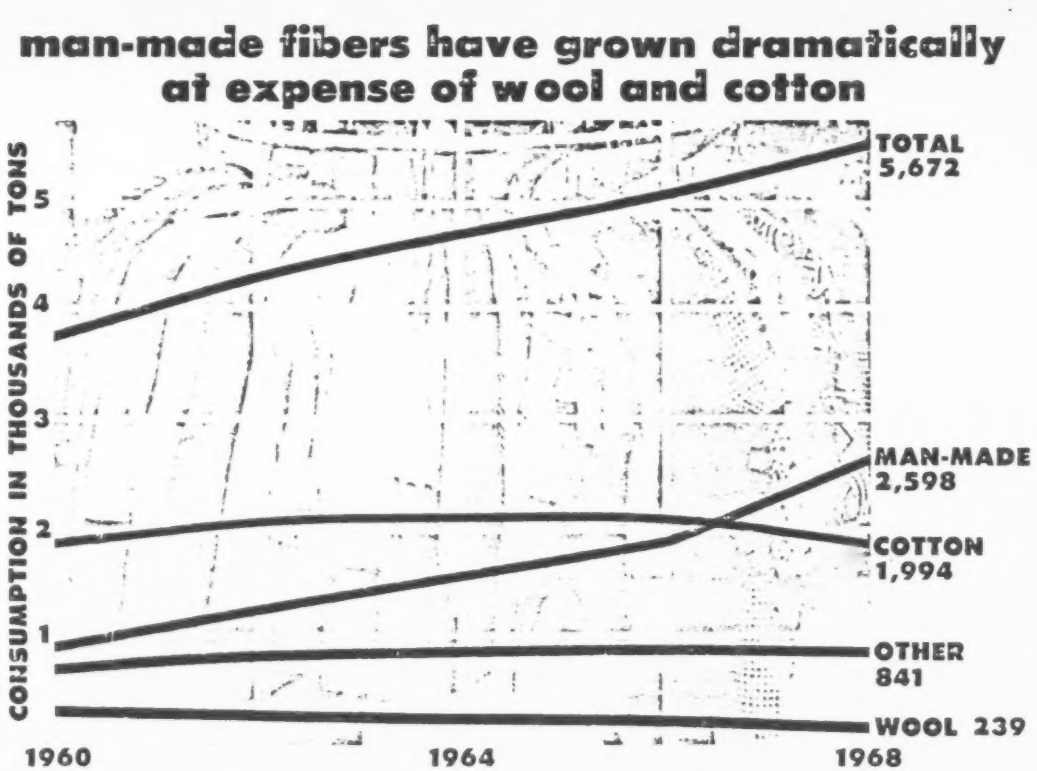
7.3.1 Research glass production in terms of availability of raw materials and energy needs for production of glass from raw materials and from scrap glass. Determine if raw materials and energy needs are different for clear glass and for colored glass. Draw up a visual aid to supplement your class presentation.

7.3.2 Find out if there are any glass recycling centers in your community. How much glass do they receive?

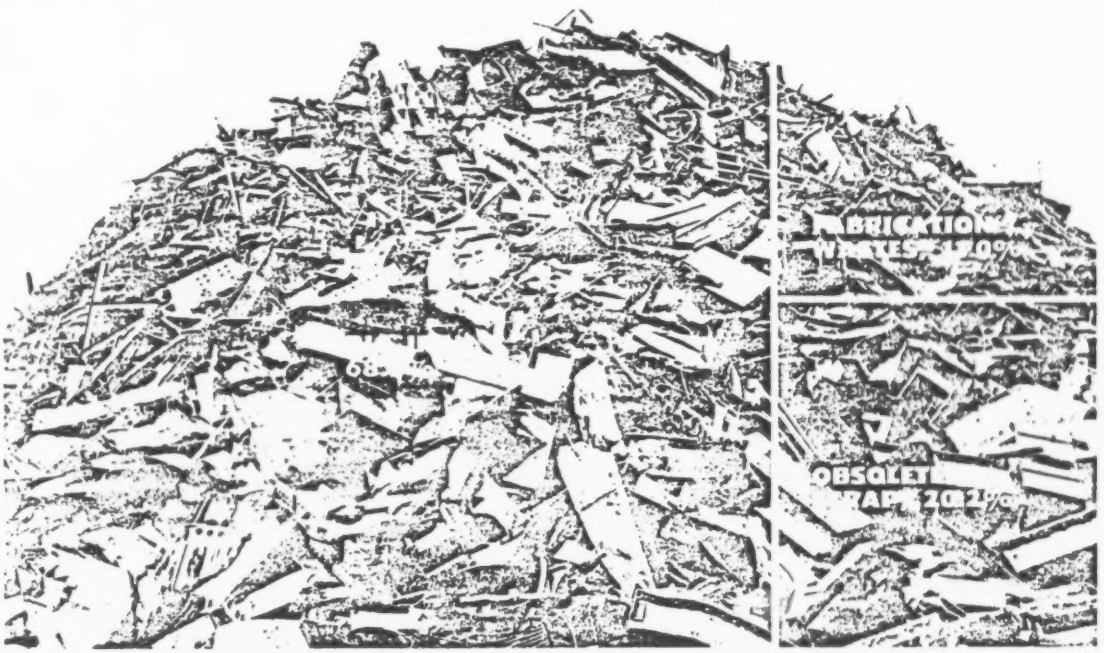
7.4 Describing our rubber resources in terms of:

U.S. production
Raw materials availability
Future U.S. needs
Energy needs for current production
Energy needs for future production

7.4.1 Visit your local library and learn how much of the rubber used in the Unites States goes into tires. Call or visit a local tire dealer and find out what he does with his scrap tires. Call or visit your local solid waste administrator and ask him how he disposes of scrap tires. Make a chart listing the advantages and disadvantages of burning scrap tires. Name some other uses for scrap tires.


man-made fibers have grown dramatically
at expense of wool and cotton
CONSUMPTION IN THOUSANDS OF TONS
5
4
3
2
1
1960
1964
1968
TOTAL
5,672
MAN-MADE
2,598
COTTON
1,994
OTHER
841
WOOL 239

scrap satisfies almost a third of the iron and steel industry's demand for metals



RECYCLED MATERIALS UTILIZATION*

	Short Tons Recycled	Approximate % of Raw Material Supply
Copper	1.6 million	42%
Aluminum	1.7 million	25%
Lead	900,000	49%
Zinc	160,000	14%
Iron and Steel	41.5 million	23%
Nickel/Stainless Steel	420,000	30%
Gold**	2.4 million (troy ounces)	35%
Silver**	99.6 million (troy ounces)	23%
Paper	12 million	20%
Textiles	1 billion (pounds)	13%
Rubber	270 million (pounds)	4%

*As percentage of total raw material usage in U.S., based on latest available industry and government estimates for 1978.

**Refinery production from scrap.

Energy Expended (in Btu) for One Gallon of Soft Drink in 16-oz Returnable and Throwaway Bottles

Operation	Returnable (8 fills)	Throwaway
Raw material acquisition	990	5,195
Transportation of raw materials	124	650
Manufacture of container	7,738	40,624
Manufacture of cap (crown)	1,935	1,935
Transportation to bottler	361	1,895
Bottling	6,100	6,100
Transportation to retailer	1,880	1,235
Retailer and consumer	-	-
Waste collection	89	468
Separation, sorting, return for processing, 30% recycle	1,102	5,782
Total energy expended in Btu per gallon:		
Recycled	19,970	62,035
Not recycled	19,220	58,100

From: "Handbook of Solid Waste Management", edited by David Gordon Wilson, Van Nostrand Reinhold Company, 1977.

ENERGY SAVINGS IN RECYCLING COMPARED WITH VIRGIN MATERIAL USE

	Tons Recycled In 1976	Energy Required To Manufacture One Ton From Virgin Material In KWH/Ton	Energy Required To Manufacture One Ton From Recycled Material In KWH/Ton	Energy Saving Per Ton By Recycling In KWH/Ton	% of Energy Savings	Total Annual Energy Saving In 1976 In KWH	Savings In 1976 Equivalent Barrels Of Crude Oil
ALUMINUM	1,433,000(1)	51,379(3)	2,000(3)	49,379	96%	70,903,000,000	41,710,000
COPPER	1,423,591(1)	13,532(3)	1,726(3)	11,805	87%	16,798,000,000	9,880,000
IRON & STEEL	46,111,452(7)	4,270(3)	1,666(3)	2,704	63%	124,685,000,000	73,340,000
LEAD	670,000(1)	2,550(4)	935(6)	1,615	63%	1,082,000,000	636,000
PAPER	10,158,000(2)	6,730(5)	2,520(5)	4,210	63%	42,765,000,000	25,156,000
RUBBER	125,000(8)	9,150(8)	2,680(8)	6,470	71%	808,750,000	475,000
ZINC	179,416(1)**	5,770(4)	2,300(6)	3,470	60%	622,573,000	366,000
**Zinc Content					TOTAL	257,664,323,000	151,563,000

SOURCES OF DATA

(1) Bureau of Mines/U S. Department of the Interior

(2) U S. Department of Commerce/Bureau of the Census

(3) Oak Ridge National Laboratory (Report #ORNL-NSF-EP-24)

(4) Battelle Memorial Institute Report PB-245759 "Energy Use Patterns in Metallurgical and Non-Metallic Mineral Processing"

(5) U S. Environmental Protection Agency "Report to Congress." February 1973. Page 11. Table 4 (Converted from BTU to KWH using standard conversion of 1 KWH = 3413 BTU)

(6) Private Communication from Arthur D. Little Corp.

(7) U S. Bureau of Mines and Arthur D. Little Estimates. (Receipts are used rather than consumption as figures for consumption do not distinguish between home and purchased scrap.)

(8) Industry Estimates

Energy Requirement in Aluminum Production from Clay.

Basis: 1 ton Aluminum

Steps	Energy Requirement (kwh)	Equivalent Coal Energy (kwh)	Power Cost ($)
Alumina Preparation			
electricity	204(E)	510(E)	1.02
steam	9,947	12,434	14.92
gas	14,228	14,228	11.81
nitric acid (0.14 ton)	300	300	0.25
Electrolysis of Alumina			
electrolysis	14,000(E)	35,000[47,040]	70
anode replacement	3,500	3,500	3.50
Total	27,975+14,204(E)	65,972[78,187]	$101.50

(E) = Electrical enerby. Numbers not in parentheses represent an electrical generation and transmission efficiency of 40%; numbers in brackets represent an efficiency of 29.8%.

From: "Handbook of Solid Waste Management", edited by David Gordon Wilson, Van Nostrand Reinhold Company, 1977.

Energy Requirements for the Steelmaking Process

	kwh/ton of raw steel
Ore mining and beneficiation	527
Coke oven-blast furnace complex	4,357
Open-hearth furnace	688
Basic oxygen furnace	120
Electric furnace	242
Slab, blooming, and strip mills	410
Finishing operations	806
Other oxygen consumed	15
Other fuels used	2,030
Total	9,195

From: "Handbook of Solid Waste Management", edited by David Gordon Wilson, Van Nostrand Reinhold Company, 1977.

8.0 The student will demonstrate a knowledge of other sources of the energy found in solid waste by:

8.1 Listing three fossil fuels and describing their origin.

(Petroleum, natural gas, and coal. The combustible materials formed many years ago by the decay of plant and animal life (organic matter).)

8.1.1 Cut out pictures from newspapers or magazines at home to show the class the many kinds of domestic fuels used to produce energy.

8.1.2 Investigate the types and sources of domestic fuels used in energy production. Show their relative cost, their relative availability and their relative efficiency in producing energy, in some type of exhibit for a school display.

8.2 Calculating the energy savings per ton earned through recycling compared to new manufacturing from virgin materials for various products.

8.2.1 Prepare a chart showing, in terms of barrels of oil, the energy used to produce one ton of each of the following from virgin materials:

Iron
Aluminum
Paper
Newsprint
Steel

On the same chart, show how much energy is needed to produce one ton of the same materials from recycled waste. Discuss how much energy could be saved if all material was recycled. Is it reasonable to assume that all of the above materials can be recycled? Discuss what you think is a good estimate.

8.3 Describing the ratio of energy savings between making new material from scrap compared with making it from virgin materials, i.e., ore, trees, for:

Aluminum - Almost 1/2 of aluminum cans in Florida are now recycled. Each ton recycled saves 90% of the energy required to make new aluminum from virgin ore.

Papermaking - Use of recycled fibers rather than virgin pulp results in 60 to 70% energy savings.

Newsprint - Making fresh newsprint from used newspapers saves 25 to 50% of the energy needed for other methods of manufacturing newsprint.

Steel - It requires 2 to 3 times the energy to manufacture a steel product with virgin ore than with recycled scrap.

Resource Lifetimes

Resource	Known Reserves	Static index (years)	Projected rate of growth (%/year)	Exponential index (years)	Exponential index calculated 5 x known reserves (years)
Aluminum	1.17×10^9 tons	100	6.4	31	55
Chromium	7.75×10^8 tons	420	2.6	95	154
Coal	5×10^{12} tons	2300	4.1	111	150
Cobalt	4.8×10^9 lb	110	1.5	60	148
Copper	308×10^6 tons	36	4.6	21	48
Gold	353×10^6 troy oz.	11	4.1	9	29
Iron	1×10^{11} tons	240	1.8	93	173
Lead	91×10^6 tons	26	2.0	21	64
Manganese	8×10^8 tons	97	2.9	46	94
Mercury	3.34×10^6 flasks	13	2.6	13	41
Molybdenum	10.8×10^9 lb	79	4.5	34	65
Natural gas	1.14×10^{15} cu ft	38	4.7	22	49
Nickel	147×10^9 lb	79	4.5	34	96
Petroleum	455×10^9 bbl	31	3.9	20	50
Platinum group	429×10^6 troy oz.	130	3.8	47	85
Silver	5.5×10^9 troy oz.	16	2.7	13	42
Tin	4.3×10^6 long tons	17	1.1	15	61
Tungsten	2.9×10^9 lb	40	2.5	28	72
Zinc	123×10^6 tons	23	2.9	18	50

This table summarizes the known reserves of some important resources and shows some measures of how long they are likely to last. The static index is simply the presently-known reserves divided by the present rate of consumption. The exponential index is a similar but more realistic measure, allowing for growth in consumption at the annual rate shown. The last column shows that, even if the reserves are really much larger, in most cases this makes only a small difference to how long they will last if consumption continues to grow exponentially.(Data: Mineral Facts and Problems, 1970, U.S. Bureau of Mines)

From: "Handbook of Solid Waste Management", edited by David Gordon Wilson, Van Nostrand Reinhold Company, 1977.

9.0 The student will demonstrate a knowledge of landfill as a waste disposal practice by:

9.1 Explaining why a landfill would be termed a non-recovery disposal practice.

9.1.1 Prepare a chart showing the map of Florida and a geometric figure of the same scale depicting the total area of land required for landfill, if all our municipal solid waste from 1970 to 1980 is buried. Add another geometric figure of one tenth the size of total landfill to depict burial area for all solid waste after incineration.

9.2 Describing differences between open dumping and landfill in terms of character and management.

Open Dump - An open land site where waste materials are burned, left to decompose, rust, or simply deposited. Provides a breading ground for disease carrying insects and rodents. May cause water pollution, create unsanitary conditions, air pollution, wasted land, and a general unsightliness.

Sanitary Landfill - A method of disposing of refuse on land without creating nuisances or hazards to public health or safety. This method requires careful preparation of the fill area and control of water draining from it. Heavy tractorlike equipment spreads the waste in thin layers, compacts it to the smallest practical volume, and then covers it with at least 6" of compacted dirt at the end of each day. After the area has been completely filled in this manner, covered with a final 2 to 3 foot layer of dirt and allowed to settle an appropriate time, the reclaimed land may be turned into a recreational area or, under carefully controlled conditions, have certain types of buildings constructed on it.

9.2.1 Draw a schematic detail of the construction of a sanitary landfill.

9.2.2 Contact your local solid waste administrator and find how your county disposes of solid waste. Find out some of the problems associated with a landfill. What type of land is most suitable for landfills? How much suitable land is there in your county? Prepare a map of your county, showing existing solid waste disposal sites. Prepare another map that shows the amount of suitable land in your county for a landfill. Prepare a chart listing the factors to be

considered when choosing a landfill site. Be sure to take into account zoning laws and residential growth patterns.

9.3 Explaining the environmental problems of landfill in areas of high water tables, such as major regions of South Florida.

9.3.1 Prepare a schematic drawing describing the problems of high water table related to sanitary landfill and present the problem to class for discussion.

9.4 Explaining in detail the suitability of conventional land disposal of solid wastes in soils with high water tables.

9.4.1 Prepare a diagram for class presentation that shows a typical section of a solid waste disposal site in a high water table area. Show the movement of ground water through the site and what happens to it as it moves through the site. Show a stream near the site and how it might be affected.

9.5 Given that Florida generates 8 million tons of solid waste annually, and one ton of wastes takes a three cubic yard volume of landfill, calculate how many acres of land will be required each year for an 8 foot deep landfill if no resource recovery takes place. Compare that area with the area of your school site.

9.5.1 Show on an overlay of a map of the United States the one-half of one million acres of land used for landfills in 1979.

9.5.2 On a highway map of the entire state of Florida, locate your county, and using the center of your county as the center of a geometric figure with an area of a half million acres, color in the area of a half million acres to show 1979 landfill area.

9.5.3 Research the subject of public use of land surface after landfill is completed. Present assets and liabilities to class for discussion. Before your presentation, have class break up into small discussion groups to develop lists of pros and cons for use of landfill surfaces. After your presentation, have the discussion groups reassemble and relist the pros and cons. Act as discussion leader in making some conclusions, judgements or summary related to the total class experience.

LAND DISPOSAL

- **The criteria and their scope**
  - EPA criteria for solid waste disposal facilities, now being developed under Section 4004 of RCRA, will define environmentally acceptable disposal.
  - Because of the broad definitions of "solid waste" and "disposal" in RCRA, the criteria will apply to almost all wastes and all forms of disposal on land, including dumps, landfills, land-spreading of sludge, and surface impoundments (pits, ponds, lagoons).
  - Main concerns are:

    Protection of the quality of ground water, surface water, and the air
    Protection of environmentally sensitive areas, such as wetlands
    Prevention of adverse health effects from spreading sludge on land used for food-chain crops
    Prevention of safety hazards and breeding of disease vectors

- **The inventory process to identify open dumps**
  - All land disposal sites (estimated at over 150,000) will be evaluated against the criteria by the States with Federal financial and technical aid.
  - These evaluations will result in an inventory of sites that fail to meet the criteria (open dumps).
  - The evaluations must be thorough since they may serve as the basis for enforcement actions. The total inventory process is expected to take much longer than the 1 year originally envisioned in RCRA.

- **Eliminating the open dumps**
  - Open dumps are to be closed or upgraded within a reasonable time after the inventory (not to exceed 5 years) in accordance with State-established compliance schedules. States must implement this program to eliminate open dumps in order to continue eligibility for Federal financial aid for their solid waste management programs.
  - States are expected to establish the regulatory powers necessary to bring about the closing or upgrading of open dumps.
  - Enforcement actions may also result from suits brought by private citizens; citizen suits are authorized by RCRA. Furthermore, the law allows the EPA Administrator to intervene through the courts upon receipt of evidence that an imminent hazard exists due to solid waste management practices.
  - In addition to financial aid, the Federal role includes technical assistance, guidelines, development of improved methods, and promotion of public education and participation.
  - In order to overcome local opposition to the establishment of disposal facilities, development of public understanding and support will have to be an essential part of the effort to upgrade land disposal.

  - EPA's preliminary estimate of the additional costs to industry, municipalities, etc., of complying with the expected criteria and with existing State standards affecting land disposal (such as ground water protection laws) is $1.7 billion a year (37 percent would be attributable to the criteria; 63 percent to State standards).

10.0 The student will demonstrate a knowledge of incineration as a waste disposal practice by:

10.1 Listing the various types of incineration being used in Florida today and their benefits.

(Pyrolysis and incineration: non-polluting, source of fuels, saves money through resale of recovered materials.)

10.1.1 Prepare a graphic display showing two types of waste materials: combustible and noncombustible. Present to class a discussion of those materials which would be eliminated by incineration, and those materials which would be taken to a landfill for burial after incineration.

10.2 Illustrating the volume reduction by incineration of solid waste. (250 tons of incinerator residue per day is equal to 2,200 tons of raw refuse per day.)

10.2.1 Construct two cardboard cubes, one depicting a measure of solid waste delivered to the incinerator and the other depicting that same measure reduced to noncombustibles after incineration. A third cube could be built depicting that same measure reduced after the reusable materials have been removed to show maximum potential reduction prior to landfill.

10.3 Describing a process by which solid wastes are converted into storable fuels. (Pyrolysis: wastes are baked in chambers in the absence of oxygen, reducing waste volume by 90%. The resultant gas has flame temperature and heat transfer characteristics similar to natural gas, but is lower in heating value.)

10.3.1 Prepare a chart listing the basic differences between pyrolysis and conventional incineration. List the end products of each process and state what is done with them. Does each process produce a useful end product?

10.4 Explaining "Urban Ore" and its characteristics.

(Residue left over after refuse is incinerated. Contains iron and steel, copper, aluminum, and some zinc, gold and silver, as well as large quantities of glass.)

10.4.1 Draw a diagram of a typical municipal incinerator showing all of the major parts. Along with this diagram, prepare a chart listing each major piece of equipment and its function.

10.4.2 Visit a municipal incinerator operation and find out what materials are left after incineration, what they look like compared to when they were discarded, what materials are or could be reused, what materials have no reuse value and are

taken to the landfill, what percentage of the delivered waste by weight or materials end up at the landfill site.

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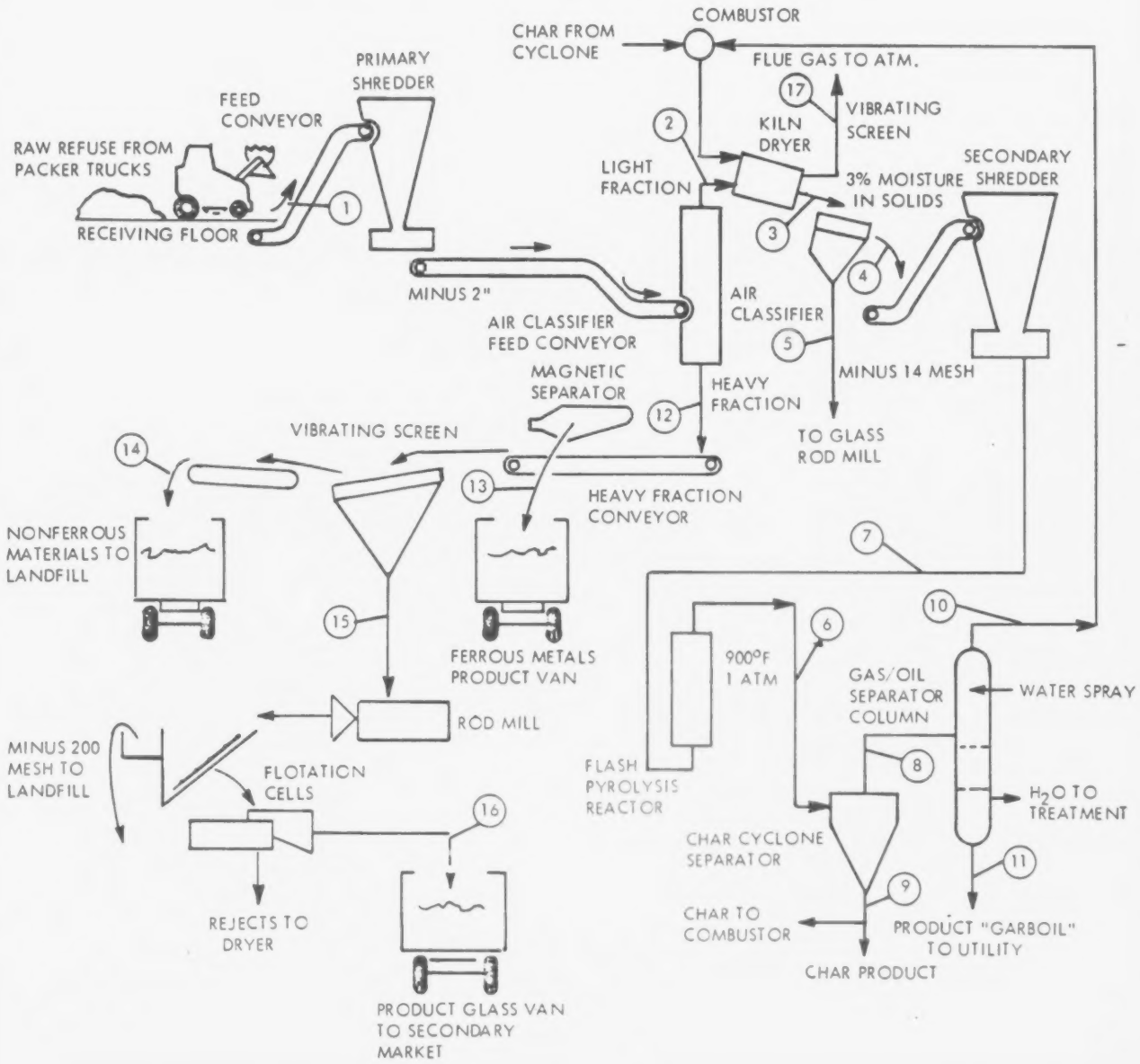
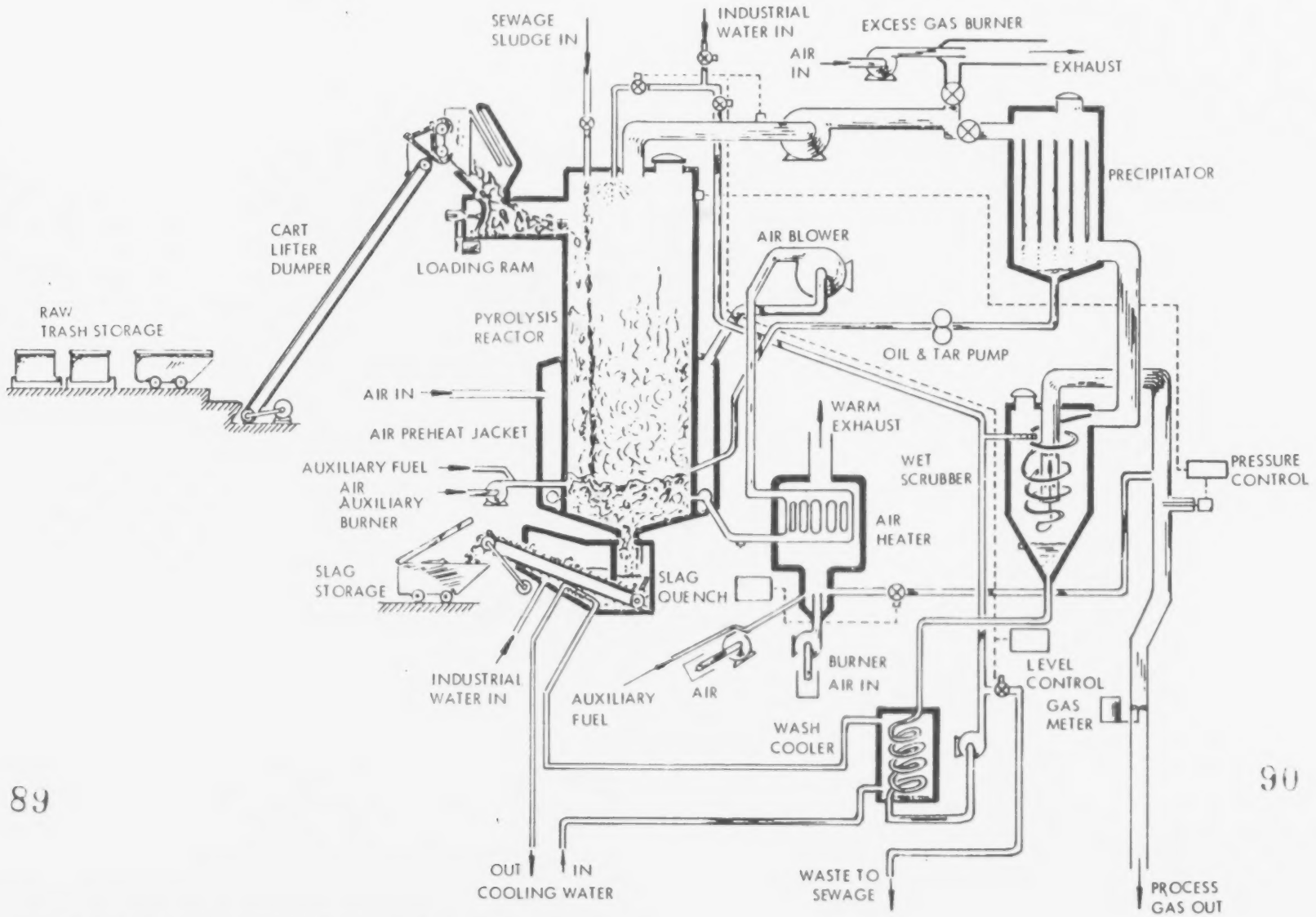


STREAM NO.		COMPONENT	TONS/DAY	TOTAL TONS/DAY	TONS PER HR PER TRAIN
1	RAW REFUSE FEED	RAW REFUSE	1000	1000	41.67
2	LIGHT FRACTION TO DRYER	LIGHT FRACTION	775	775	
3	LIGHT FRACTION FROM DRYER	LIGHT FRACTION	775	775	
4	FEED TO SECONDARY SHREDDER	LIGHT FRACTION	774	774	
5	SCREENED GLASS FROM LIGHT FRACTION	GLASS, CERAMICS, ETC.	23	23	
6	FEED TO PYROLYSIS REACTOR	LIGHT FRACTION	774	774	
7	PYROLYSIS PRODUCT TO CYCLONE SEPARATOR	GAS	83		
		CHAR	691	774	
8	GAS/OIL SEPARATOR COLUMN	OIL	691		
		GAS	83	774	
9	CHAR FROM PYROLYSIS PRODUCTS	CHAR	83	83	
10	GAS FROM GAS/OIL SEPARATOR	GAS	83	83	
11	PRODUCT PYROLYSIS OIL	OIL	240	240	
12	HEAVY FRACTION FROM AIR CLASSIFIER	HEAVY FRACTION	225	225	
13	FERROUS METALS FROM MAGNETIC SEPARATOR	FERROUS METALS	70	70	
14	NONFERROUS MATERIALS TO LANDFILL	NONFERROUS MATERIALS	55	55	
15	SCREENED GLASS, CERAMICS, ETC. TO ROD MILL	GLASS, CERAMICS, ETC.	700	700	
16	PRODUCT GLASS FROM FLOTATION CELLS	GLASS PRODUCT	82	82	
17	WATER REMOVED FROM LIGHT FRACTION	WATER	111	111	

1. BASED ON 24 HR/DAY OPERATION OF SECONDARY SHREDDER (OPERATES 13 HRS/DAY, 5 DAYS/WEEK TO PRODUCE 775 TPD).
2. PYROLYSIS REACTOR SIZED TO OPERATE 24 HRS/DAY, 7 DAYS/WEEK. LARGEST MODULE SIZE NOT RELEASED BY GARRETT.

SOURCE: GARRETT RESEARCH AND DEVELOPMENT CO.

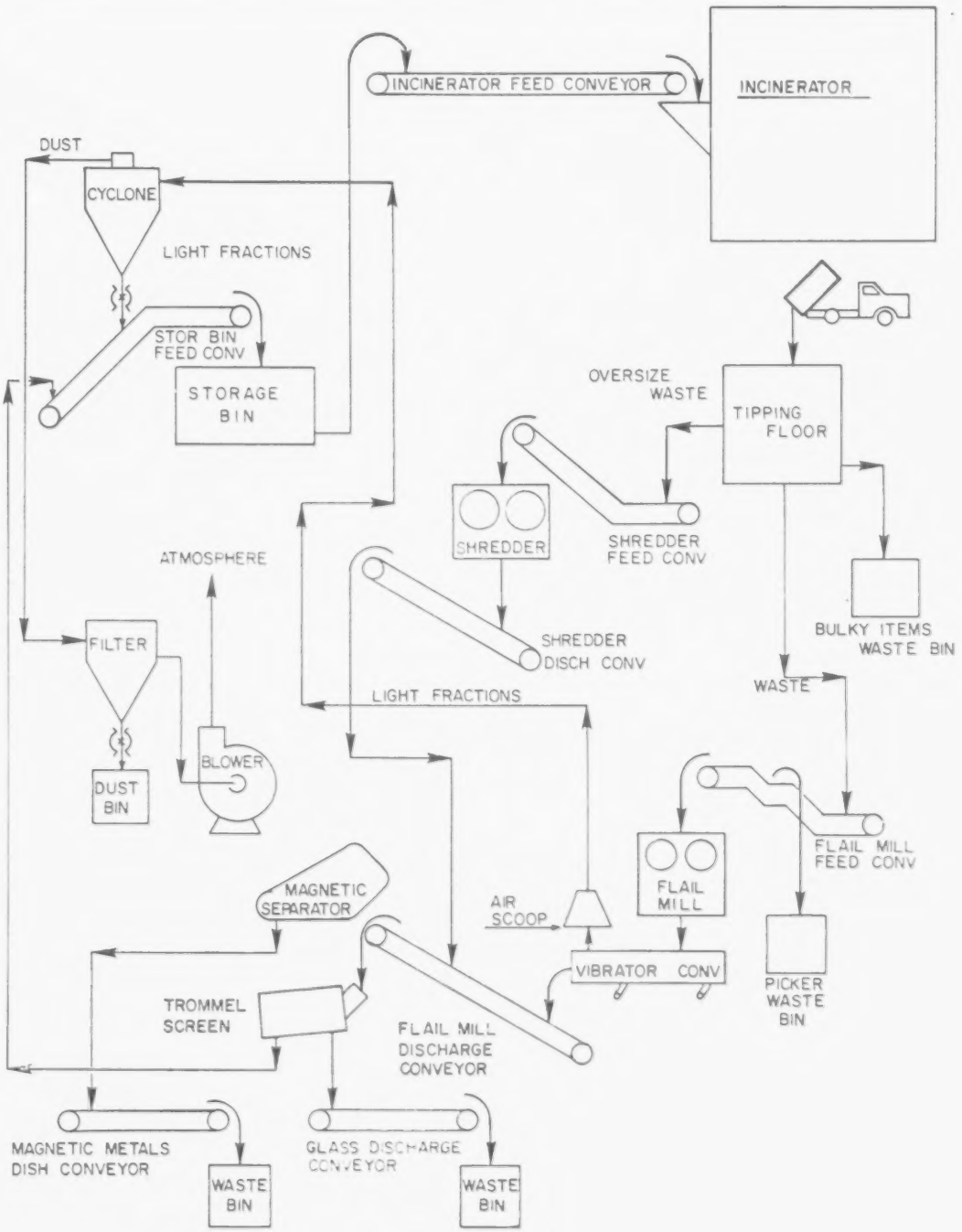
PROCESS TYPE 3 - PYROLYSIS OF MSW TO A FUEL OIL



URDC PYROLYSIS SYSTEM SCHEMATIC

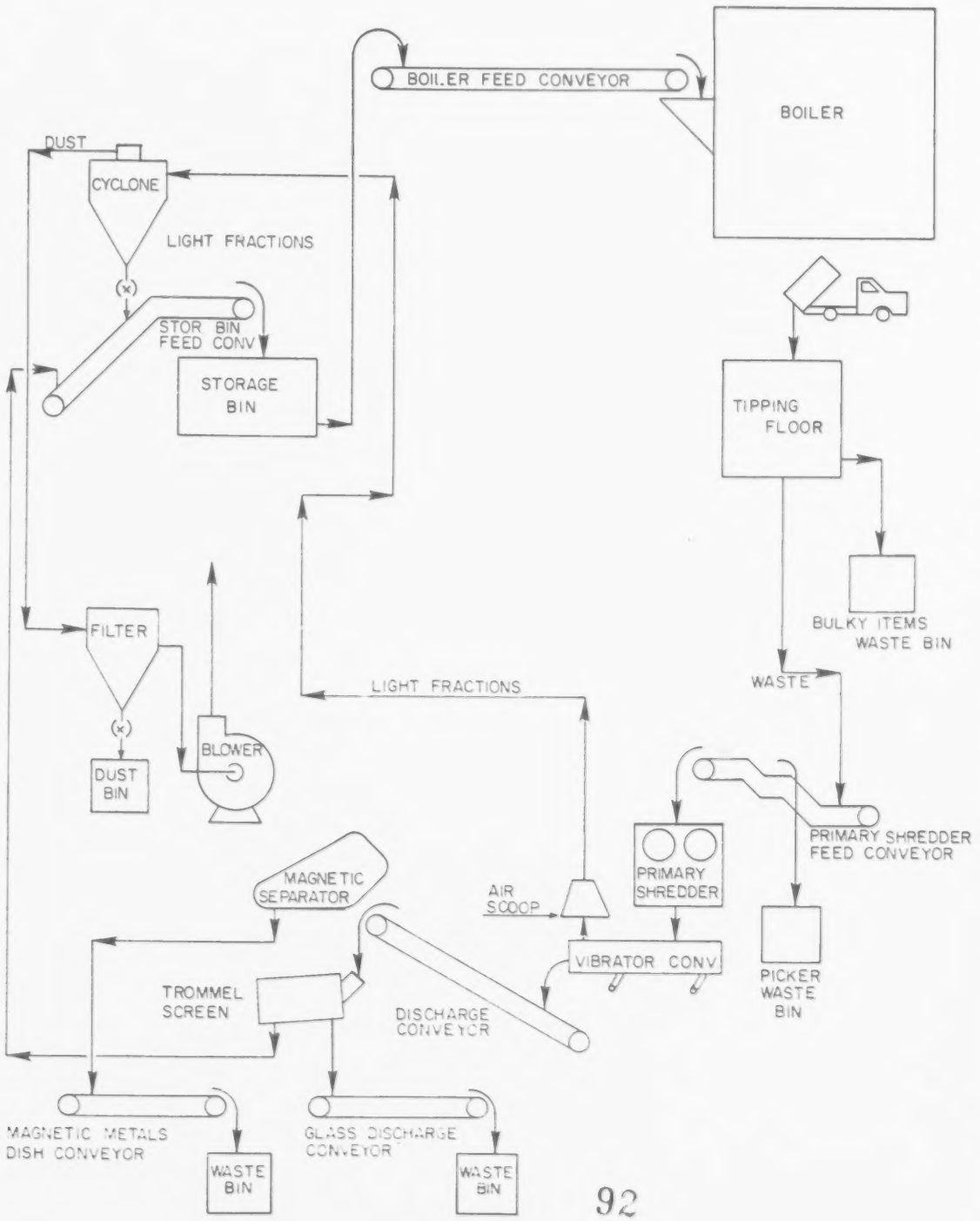
exhibit sheet-10.0

INCINERATOR
TYPICAL SOLID WASTE PREPROCESSING SYSTEM



BOILER

TYPICAL SOLID WASTE PREPROCESSING SYSTEM



Waste heat recovery makes sense

Small incinerator economics looks much better when heat from stack gases can be recovered and put to use

Reprinted from Environ. Sci. Technol., 6, 219 (March 1972)

Sometimes "new technology" is simply a matter of applying old technology to new situations. Take steam-raising incinerators for instance. While using waste heat generated from burning municipal refuse is not really old hat, it's been done successfully for years in Europe and the idea is beginning to catch on in North America as well (see "Plants burn garbage, produce steam," ES&T, March 1971, p 207). All of which raises a question: If waste heat recovery makes economic sense for municipal incinerators, why wouldn't it be advantageous to trap some of the heat that goes up the chimneys in smaller units, say those in apartment complexes or commercial buildings?

A. W. Hindenlang, vice-president for engineering at Ecology Industries, Inc. (S. Plainfield, NJ) says it would make sense. Ecology Industries is marketing a modular solid waste handling and disposal system—aimed primarily at hospitals—which includes a boiler for trapping heat that can be used in-house for producing heat or hot water.

Although the system could work in apartment houses or virtually any reasonably sized commercial building, says Ecology Industry's President William Carey, hospitals provide an especially favorable proving ground for the concept because of the high volumes of waste generated. Only a few years ago, an average figure for hospital waste production cited by the Incineration Institute of America was 8 lb/person/day. That figure was recently revised upward to 15 lb/person/day. Because the use of disposables in hospitals continues to grow at a phenomenal rate, Hindenlang says, the figure could reach 25 lb/person/day within the next five years.

Hindenlang argues the economic case for on-site disposal and heat recovery this way: A hypothetical 800-bed hospital with clinical and laboratory facilities could be expected to generate about 15,000 lb of wastes per day. That much waste could easily cost $75 per day just to cart away.

Hospital waste has an average heat content of about 7624 Btu/lb—or a total of 114.3 million Btu per day at the 800-bed hospital. If the waste were to be burned and the heat recovered down to an exit gas temperature of 600°F, the total dry gas, moisture, and radiation loss would be about 1600 Btu/lb. That means a net heat energy of 6025 Btu/lb or a total of 90.3 million Btu/day can be recuperated.

If that energy were converted for use in the hospital, the fuel bill reduction (assuming a 60-cent per million Btu fuel cost) would be $54.14 per day. That figure added to the savings resulting from elimination of hauling the waste away yields a gross savings of $129.18 per day or better than $47,000 annually.

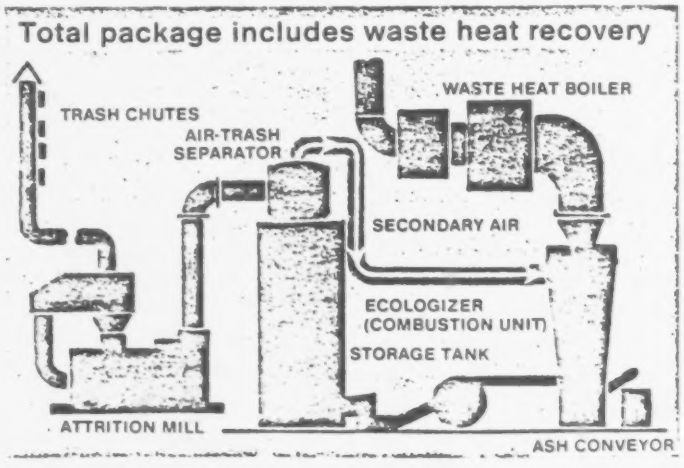
These figures ignore contributions to overall community air pollution problems and the benefit of reducing demand on the national energy supply because return to the individual institution is intangible. "However," Hindenlang says, "we feel that widespread adoption of such a process would contribute greatly to both these areas."

Total package

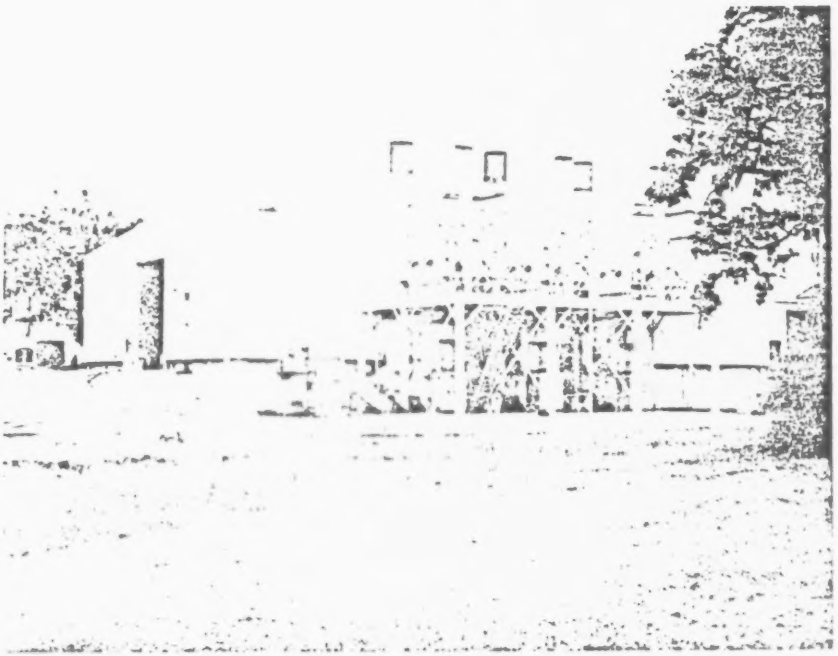
Ecology Industries' system is a modular collection and disposal package that allows a hospital to take as much or as little as it needs. The complete package begins with a collection system and ends up with the boiler. Waste is deposited in a central collection chute where it drops into an attrition mill that grinds unsorted materials and reduces total volume by as much as 80%. Once through the mill, ground refuse goes to a storage unit, intended to provide a uniform flow of material to the burner.

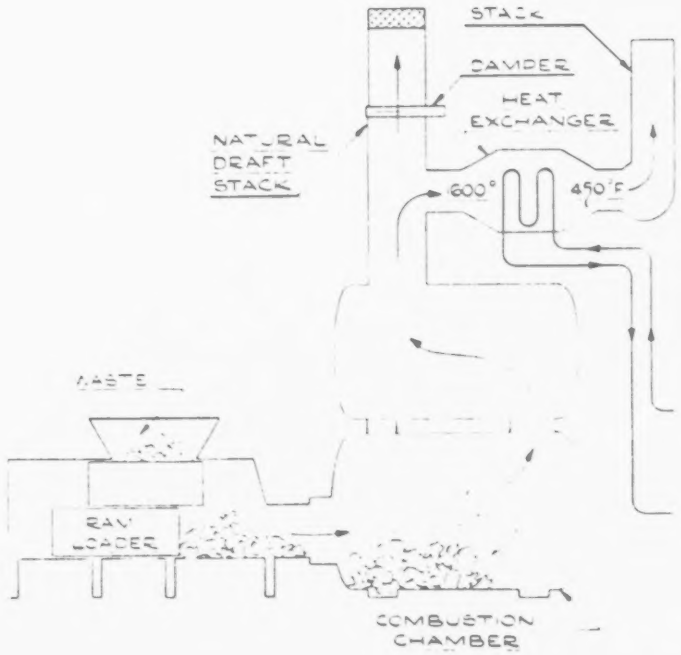
The heart of the system is the combustion unit, dubbed an "Ecologizer." Ground waste is injected pneumatically at the bottom through a burner flame. Combustibles are consumed during their upward trek through the unit by introduction of preheated secondary air. The whirling motion produced by the tangential air injection mixes fuel and air and separates particulate matter at the top of the unit. Ash falls into quenching water at the bottom of the combustion chamber and is conveyed to an outside conveyor. Hot gases fire the boiler atop the unit and, at the same time, are cooled to the point where remaining particulate matter can be removed by a precipitator.

Although Ecology Industries has not yet tested a completed installation, the first system complete with a waste heat recovery unit is scheduled to go into operation in a Chicago hospital later this month. Several units without waste heat recovery have been installed and are working fine. HMM



SOLID WASTE DISPOSAL WITH HEAT RECOVERY





11.0 The student will demonstrate knowledge of current methods to recover resources from solid waste by:

11.1 Listing current methods employed in Florida. (Industrial Separation, Source Separation, Mixed Waste Processing, Incineration, Composting.)

11.1.1 Prepare a chart listing the various methods of resource recovery. List the basic differences and similarities. What is the overall objective of each method? Are they the same or similar? Give examples of where each method would be used and why.

11.2 Describing source separation and listing Florida facilities of this type, especially local.

11.2.1 Prepare a collection from your household's solid waste, to include all items that you could personally keep separate for pick up or delivery to a recycling unit. Calculate how much money could be earned each week or month by your source separation efforts.

11.2.2 Evaluate your home refuse and calculate the percentage of the total, by weight, which your family could keep separate for recycling. Further evaluate the quantity remaining for refuse pickup to determine, by weight, the percentages of combustibles and noncombustibles.

11.3 Describing industrial separation and listing Florida facilities of this type.

11.3.1 Visit a local industry to determine what materials they separate for recycling from their solid waste generation. Obtain small samples of materials recycled and include in a display for class presentation.

11.3.2 Given the following list of typical categories found in the "Yellow Pages", contact and report to class on a local facility involved in Resource Recovery Industry:

Chemicals - reclaiming
Glass - broken
Junk dealers
Oils - waste
Recycling centers
Scrap metals
Solvents - reclaiming
Waste containers
Waste paper
Waste reduction disposal and recycling equipment - industrial
Waste reduction disposal and recycling service - industrial

Include in your report how much material the facility handles in a week. How much raw material is saved by recycling? Find out where the recycled material goes when it leaves the facility. Is it converted back into the same item it was previously?

11.3.3 Cut up or photocopy your local "Yellow Pages" for the above categories. Mount them on some illustration board in a useful manner to show your schoolmates the extent of your local resource recovery industry.

11.4 Describing mixed (municipal) waste processing and listing Florida facilities of this type.

11.4.1 Prepare a list and description of all the mixed waste processing facilities in Florida.

11.4.2 Visit a local mixed waste processing facility. Take notes on the processes involved. Prepare a flow diagram showing how the facility operates. Include an explanation of the major items of equipment.

11.4.3 Call the Reynolds Aluminum Company (800/243-6000) to find out: where the closest aluminum recycling unit is, how much they are paying for a pound of aluminum cans, TV dinner trays, foil and pie plates, and how much for other aluminum scraps.

11.4.4 Investigate the literature on Solid Waste Management and prepare a bibliography of current research on mixed waste processing.

11.4.5 You and a classmate prepare for a debate. One will argue that mixed waste processing is the most economic solution to resource recovery, which may be generalized as the manufacturing industry point of view. The other will argue that source separation is the most economical solution to resource recovery which may be generalized as the recycling industry point of view. Invite a local manufacturer and a local scrap handler to sit on your panel and answer questions or to make their own debate the day before or after.

11.5 Describing incineration as a method to recover inorganic resources from solid waste.

11.5.1 Prepare a list and description of all the solid waste incineration facilities in Florida.

11.5.2 Investigate the literature on solid waste management and prepare a bibliography of current research on incineration and pyrolysis.

11.5.3 Visit a local solid waste incineration facility. How much solid waste is handled by this facility? Find out if the

facility performs any type of classification. What is done with these materials? Find out if there are any particular items which are troublesome. How are these handled and disposed of? Is the facility equipped to recover the incineration products, i.e., heat and metals remaining after incineration? If not, are there any plans to do this?

11.6 Describing composting as a method of recovering resources from solid organic wastes.

(Uses bacterial and chemical processes to convert organic wastes into soil conditioners. A controlled biological degradation of organic waste yielding a nuisance-free product of potential value as a soil conditioner. The process of using microorganisms to convert organic material into humus for soil conditioners and low grade fertilizers.)

11.6.1 Prepare a poster that shows how composting works. Show what types of material are suitable and unsuitable for composting. What conditions are necessary to start and maintain a compost pile?

11.6.2 Make a compost pile.

1) Take two plastic bags (one inside the other) and a "twist tie". Collect bits of organic matter such as grass clippings, leaves, weeds, etc. Break them up into small pieces before placing them in the bag.

2) Also add some "garbage" (peelings, table scraps, vegetables, bread, meat). Fill your bag 1/2 to 3/4 full. Add some small pieces of inorganic matter such as aluminum foil, plastics.

3) Add only enough water to thoroughly moisten the contents of the compost bag, do not waterlog it.

4) Close the bag with the "twist tie" and gently knead it for a few minutes to further shred the material. Repeat this once a day for the first 7 to 10 days.

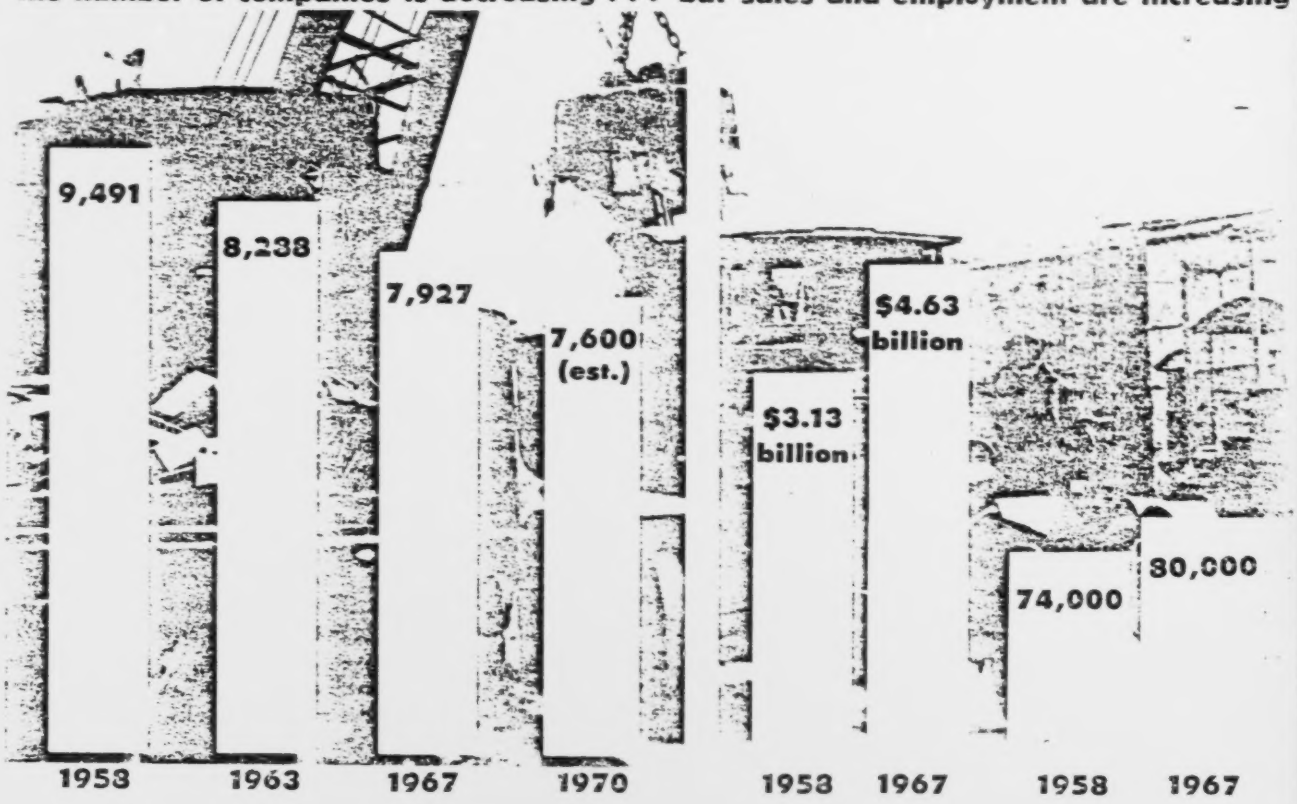
5) Open the bag every other day to allow oxygen to enter.

6) After two to three weeks the compost should be ready.

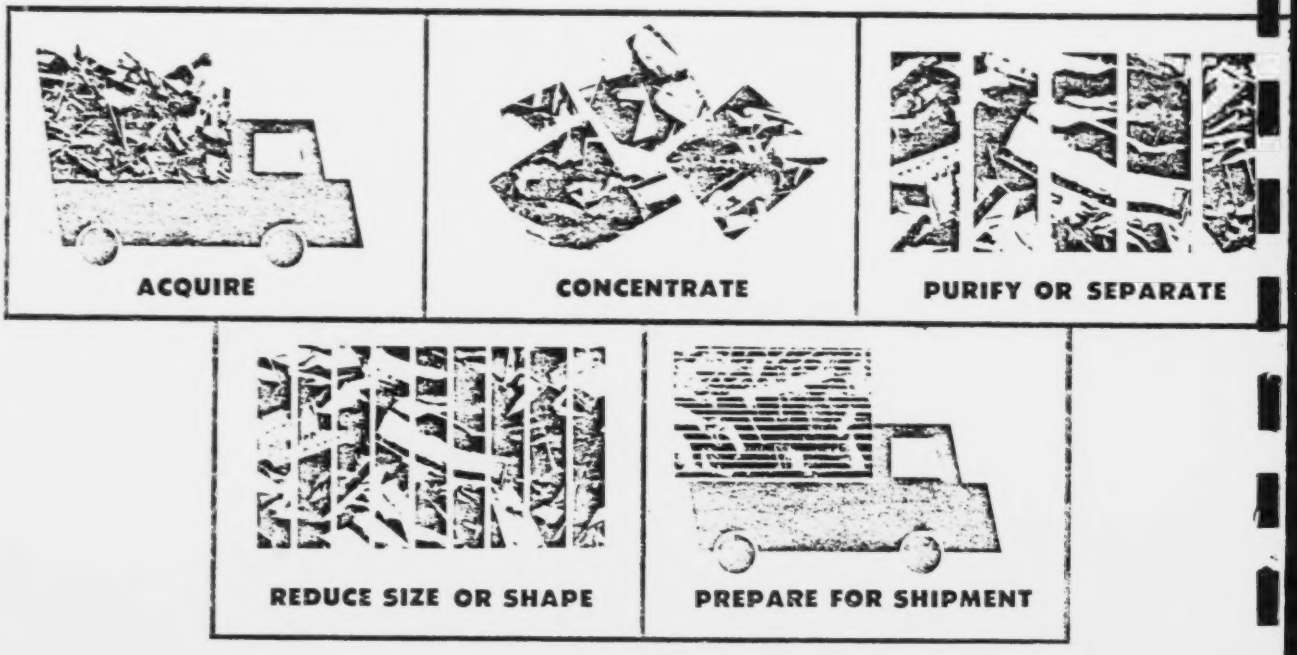
What has happened to the organic material? What has happened to the inorganic material? Mix the compost with an equal portion of soil and place it in a pot. Get another pot and fill it with the same amount of plain soil. Plant a few seeds in each pot and record which container grows better plants.

salvage industry is centralizing

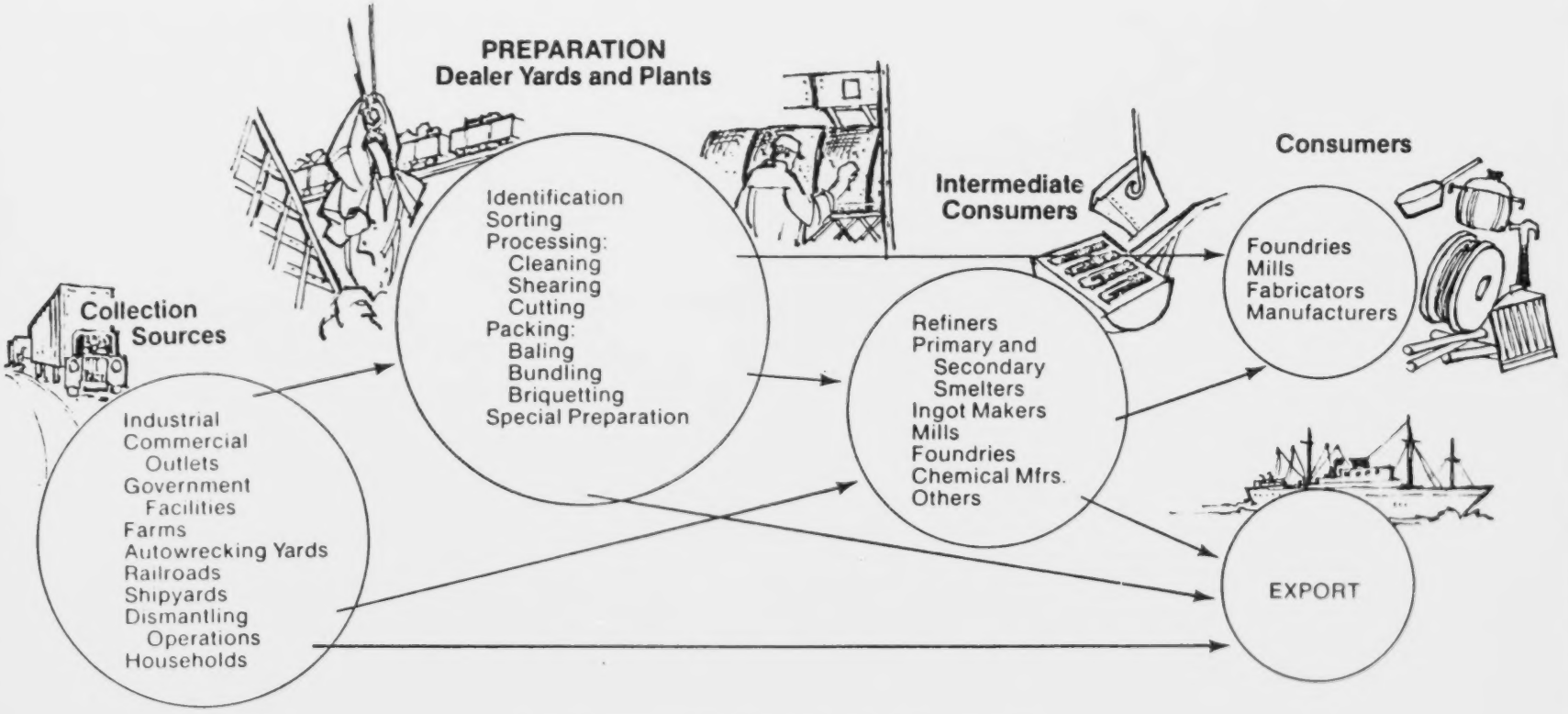
the number of companies is decreasing . . . but sales and employment are increasing



salvage industry performs up to five operations in recovering waste commodities



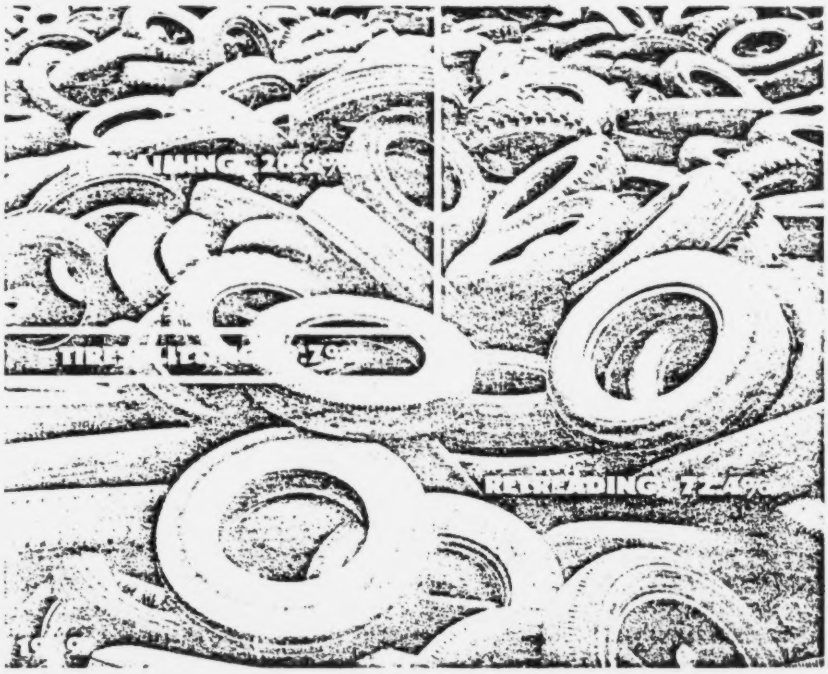
FLOW CHART OF NONFERROUS SCRAP METALS



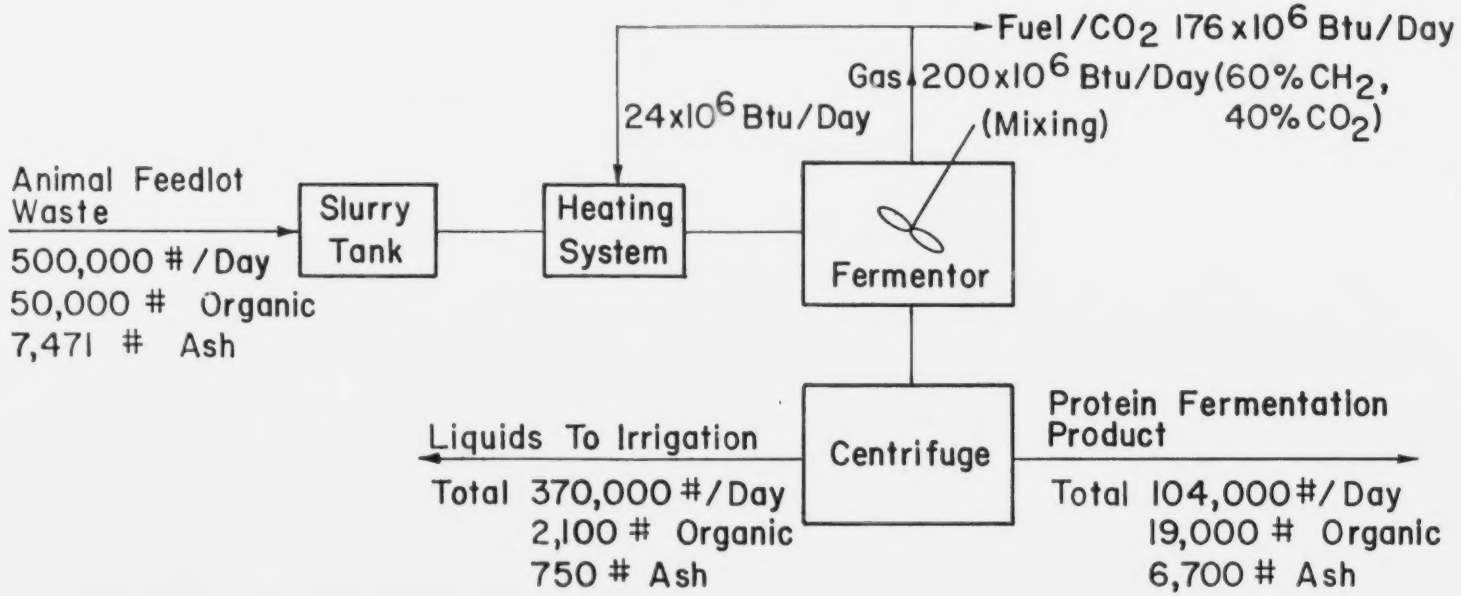
The scrap processor's yard is the true recycling center

exhibit sheet-11.0

retreading is principal form of rubber recycling



SIMPLIFIED BLOCK DIAGRAM OF ANAEROBIC FERMENTATION PROCESS



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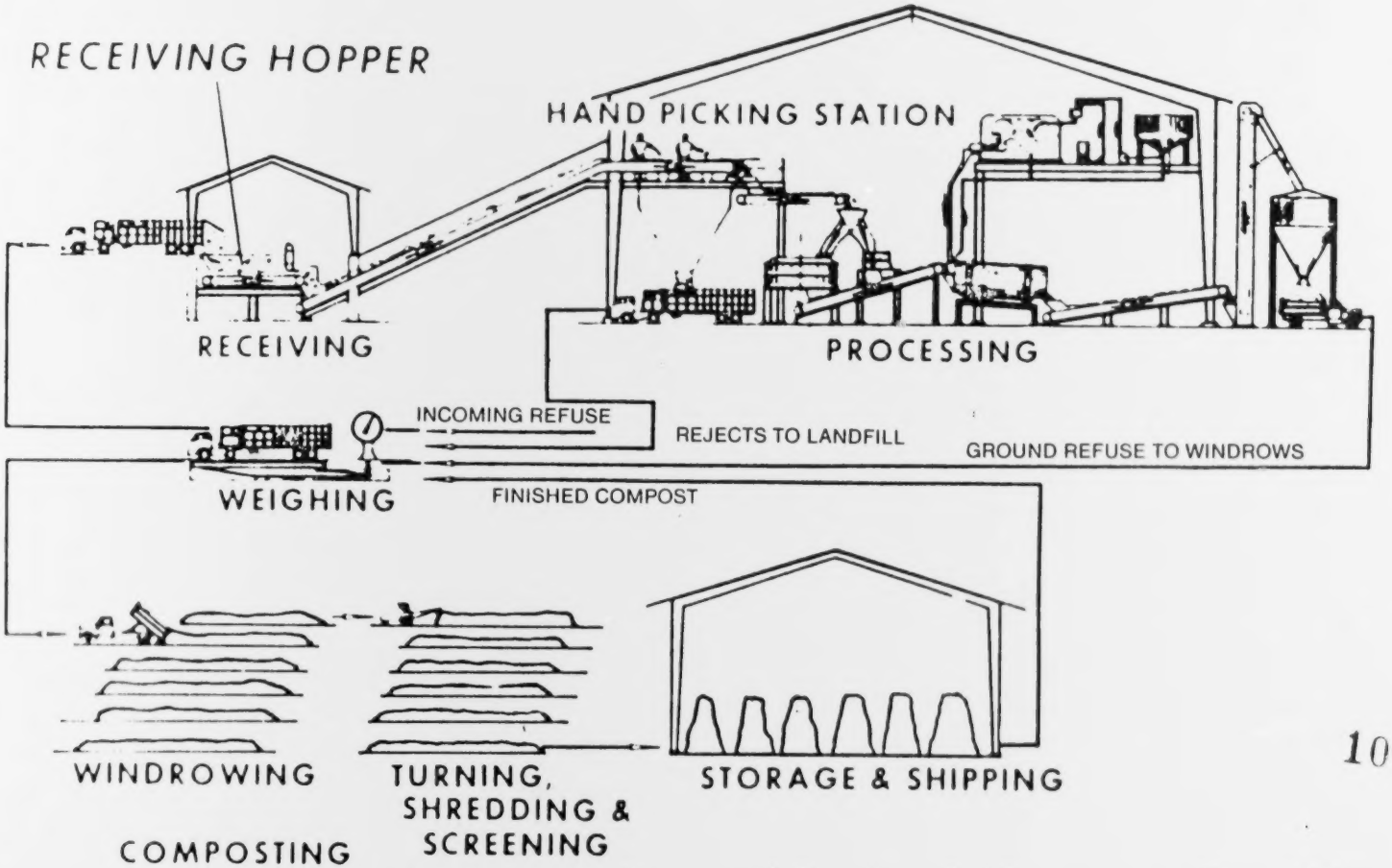

RECEIVING HOPPER
HAND PICKING STATION
RECEIVING
PROCESSING
INCOMING REFUSE
REJECTS TO LANDFILL
GROUND REFUSE TO WINDROWS
WEIGHING
FINISHED COMPOST
WINDROWING
TURNING, SHREDDING & SCREENING
STORAGE & SHIPPING
COMPOSTING

. . . in resource recovery

"...in resource recovery" presents selected items of interest concerning resource recovery activities, and is not intended as a complete report. Contributions to this feature are welcome; selection of items to be published is made by the editors.

WASHINGTON, D.C.

On the federal level, several recent actions were taken that hold promise of stimulating or assisting resource recovery projects. On October 24, Sen. William Bradley (D-N.J.) introduced legislation for consideration by the Senate Energy Committee. The bill would establish a price support loan program for energy-from-solid waste projects. The program has, as an objective, the lowering of project costs during the early years of a project, with payback to come later when more favorable economics can be expected. Hearings on the bill are planned for early in the year.

Then on November 9, Rep. James Florio (D-N.J.) introduced a bill in the House of Representatives to provide $12 million a year in financial assistance to states and localities for resource recovery planning. Specifically, the bill would authorize $4 million per year in grants to states for planning and assistance to localities in developing plans; states could make all or part of their grants available to localities. Another $8 million would be authorized for grants to localities, but grant applications would have to be approved by the states, to ensure that local plans are consistent with state-wide plans. The bill has been referred to the House Subcommittee on Transportation and Commerce, chaired by Rep. Florio.

The Oil Entitlements Program has been amended by the Department of Energy's Economic Regulatory Administration (ERA) to include fuel from municipal solid waste. The program, administered by the ERA, is basically designed to equalize the cost of acquiring crude oil among U.S. refiners by requiring fund transfers among refiners who purchase price-controlled domestic oil and those who must purchase imported oil at world market prices. The ERA's regulations have now extended the program to include several petroleum substitutes, including refuse-derived fuel and methane from municipal sewage and landfills.

The ERA rules, issued in November, provide that, according to a formula, entitlements may be issued to municipal solid waste processors whose energy produce is used or sold for use domestically as fuel. Collectors of methane from landfills and municipal sewage also may earn entitlement credits, according to a formula that includes the heating value of the methane produced, when the methane is used or sold for use domestically as fuel.

DELAWARE

In Wilmington, site preparation and construction began in September for a solid waste/sewage sludge codisposal facility, after groundbreaking ceremonies in August. Construction of the plant is scheduled for completion in August 1981. Raytheon Service Co. is the designer and operator of the plant, which will process 1000 tons per day (TPD) of solid waste and 350 TPD of sewage sludge. Refuse-derived fuel will be produced and burned at an on-site facility for cogeneration of electricity and steam for industrial use; proposals for that power plant were received by the Delaware Solid Waste Authority in mid-November. Ferrous and nonferrous metals and glass will be recovered, and a humus product from aerobic digestion will be produced, for which Raytheon is currently exploring markets. The plant is partially funded by the Environmental Protection Agency as a demonstration facility.

FLORIDA

Walt Disney World will turn its trash into hot water with a slagging pyrolysis incinerator scheduled to begin construction in about a year. The Department of Energy (DOE) and Walt Disney Productions have signed an agreement for a demonstration facility to generate steam and hot water by the Andco-Torrax pyrolysis process. The 100 ton-per-day plant will burn Disney World's 45-50 TPD of refuse, plus about 50 TPD from surrounding Orange County, to generate about 20 percent of the "magic kingdom's" hot water needs. Construction is expected to be completed in late 1982, with DOE conducting tests there for one year. DOE also will have access to the plant periodically for various tests, particularly those applicable to a similar plant planned for the Idaho National Engineering Laboratory for radioactive waste disposal.

NEW JERSEY

A Riverton, N.J., firm has begun using methane gas from a nearby landfill as a supplement to natural gas for part of its energy needs. The Hoeganaes Corp., which makes metal powders used in some manufacturing processes, expects the methane to supply 15-20 percent of its energy requirements for about 10 years. The gas is from a landfill owned by Sanitary Landfill, Inc.; the methane wells were sunk by Public Service Electric and Gas Co. *This is believed to be the first industrial use of landfill methane gas in the U.S.*

OHIO

Akron's "Recycle Energy System" is continuing shakedown operations and nearing its designed operating capacity of 1000 TPD of municipal solid waste. In late October, the plant was processing 300-500 TPD and producing 100,000 lbs. hr. of steam, which is being sold to B.F. Goodrich Co. and Ohio Edison. These figures are up from 200 TPD and 30,000 lbs. hr. in late July.

MAJOR MARKETS FOR RECYCLED MATERIALS

Copper	Automotive Components Electrical Equipment Household Utensils Military Ordnance Power Generators Tubing Wire and Cable
Aluminum	Aircraft, Automobiles, other Vehicles Building and Construction Containers and Packaging Household Appliances and Cookware
Iron and Steel	Construction Motor Vehicles and Parts Machinery Railroads and Railroad Equipment Appliances Containers
Lead	Ammunition Batteries Cable Sheathing Gasoline Additives Printing Type Solder
Zinc	Brassmaking Die-Casts for Automotive and other Industrial and Consumer Uses Galvanizing and Coatings Oxides and Chemicals
Nickel/Stainless Steel	Aerospace Automobiles and other Vehicles Construction Household Appliances and Cutlery Machinery, Tools and Instruments Shipbuilding
Precious Metals	Decorative Ware Dental Fittings Electrical and Electronic Jewelry Photographic Materials
Paper	Boxes, Containers and Paperboard Packaging Insulation and Construction Newsprint Stationery and Books Towels, Tissues, Napkins
Textiles	Apparel, Blankets, Carpeting Batting and Padding Fine Paper and Currency Flock and Filler Roofing and Flooring Vulcanized Materials Wiping Cloths
Rubber	Asphalt Paving Hosing and Molded Parts New Tires Roofing and Siding

TYPES OF RECYCLING COMPANIES

Class of Company	Description of Operations
Scrap Metal Processor	(1) Locates scrap (2) Purchases (3) Identifies (4) Sorts and separates (5) Sizes the scrap (6) Densifies (7) Markets (8) Delivers
Metal Broker	(1) Locates scrap sellers (2) Locates scrap customers (3) Buys (4) Markets scrap (5) Arranges pick up and delivery (6) Stabilizes source of supply
Metal Smelter & Refiner	(1) Buys scrap (2) Upgrades by adjusting composition and casting into ingots or pigs (3) Markets scrap
Metal Sweater	(1) Buys scrap (2) Upgrades by melting one metal and separating from other metals with higher melting points that remain solid (3) Casts into ingots or pigs (4) Markets scrap
Metal Ingot Maker	(1) Buys scrap (2) Melts selected scrap to composition and casts into ingots (3) Markets scrap
Brass Mill	(1) Buys scrap (2) Melts selected scrap and other materials to composition and casts into ingot (3) Produces sheet, strip and other shapes from ingots (4) Markets shapes to size and specification
Primary Metal Producer	(1) May mine ores or purchase ores (2) May concentrate ores or purchase concentrates (3) Buys scrap (4) Sometimes also operates as secondary smelter
Importer & Exporter	(1) Locates domestic or foreign scrap sources (2) Locates domestic or foreign scrap customers (3) Buys (4) Markets scrap (5) Arranges transportation
Laboratory & Assayer	(1) Analyzes materials (2) Certifies composition
Manufacturer of Equipment	(1) Designs and manufactures equipment (2) Includes equipment for recycling industry
Paper Stock Processor	(1) Collects waste paper from generators or collectors (2) Sorts and separates waste paper; and bales as paper stock (3) Sells paper stock to industrial users
Paper/Paperboard Mills	(1) Purchase paper stock as raw materials furnish (2) Manufacture paper and/or paperboard products
Scrap Rubber Processor/ Reclaimer	(1) Locates scrap (2) Sorts by chemical type (3) Mechanically or chemically processes scrap (4) Markets scrap
Textile Dealer	(1) Buys and sells scrap (2) Sorts into categories (3) Acts as broker (4) Processes (cuts, washes, etc.)
Textile Garnetter	(1) Buys processed scrap (2) Sorts (3) Shred and combs (4) Markets material to manufacturers

- **To create a "demand pull" for recycled materials, RCRA requires** Federal agencies to procure items containing the highest percentage of recycled materials practicable, effective October 1978. State and local governments and contractors must also meet this requirement in purchasing with Federal funds. EPA is developing guidelines on how to comply with this requirement.

- **Source separation of office paper is rapidly growing due to 1976 EPA guidelines:**
  - Impact of guidelines on Federal agencies:

	1975	1977	1980 projections
Buildings	Less than 25	90	500
Employees	No involvement	114,000	500,500

  - Savings amounting to about $7 million per year are expected to result from wastepaper recovery from Federal facilities.
  - Roughly 15 State governments and many private firms are also carrying out office wastepaper recovery.

- **Deposits on beverage containers** could help maximize recovery of materials from municipal solid waste and greatly reduce litter.

- **Magnetic separation of ferrous metals** is technically and economically practical. Mechanical separation of glass and aluminum are under development. Feasibility of glass recovery is questionable.

- **Used lubricating oil** is a potential resource and a potential hazard. Rerefining the oil for reuse as a lubricant is the most energy-conserving method of utilizing the oil. About 10 percent of waste lube oil is being rerefined in this country, compared with about 50 percent reported for the European Economic Community. Unless properly managed, waste oil can cause environmental and health hazards; the lead content is of particular concern.

- **Industrial waste exchanges or clearinghouses** are promoting awareness and use of waste materials among industries: one factory's waste can be another factory's raw material. About 17 waste exchanges have been established recently in the United States, stimulated by rising costs of materials and waste management.

- **Major EPA program thrust**

  Provide resource conservation as an alternative to disposal through:
  - Technical assistance
  - Financial assistance for State and local planning and implementation
  - Development of economic incentives through the Resource Conservation Committee, which is studying beverage container deposits, product disposal charges, litter taxes, and other policies
  - Research, development, demonstrations, and evaluations of technologies and systems for resource conservation

RESOURCE RECOVERY ACTIVITIES

Reprinted from NCRR BULLETIN

National Center for Resource Recovery, Inc.
1211 Connecticut Ave. N.W., Washington, D.C. 20036

March 1980
Vol. 10, No. 1

For several years, NCRR has been tracking resource recovery activities in the U.S. and publishing periodic summaries. Because of the growing interest in systems to moderate solid waste disposal problems while recovering recyclables and energy products—plus a growing number of projects being undertaken—we have adapted the listing to a regular feature in every other issue of the *NCRR Bulletin*.

The listing is broken down into four segments for ease of review: (1) capital-intensive energy and materials recovery facilities that are built, operating, in shakedown, under construction or in contract-signing stages; (2) smaller, controlled-air or modular combustion projects; (3) methane recovery from sanitary landfills projects; and (4) jurisdictions where commitments have been reported to undertake resource recovery projects. In addition to the systems listed here, a number of communities are magnetically separating ferrous metals and conducting source separation programs for old newspapers, etc.

Although every effort has been made to make this report complete and up-to-date, the dynamics of resource recovery are such that the status of projects can change at any time. For clarification or additional information, therefore, we suggest that you write directly to the contacts listed.

We are grateful for the review and input by the various project representatives, as well as that from local, state and federal officials, particularly the U.S. Environmental Protection Agency and the U.S. Department of Energy.

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Akron, Ohio	City; Glaus, Pyle, Schomer, Burns & De Haven; Ruhlin Const. Co.; Babcock & Wilcox Co. (boiler supplier); Teledyne National (operator)	Shredding; air classification; magnetic separation; burning RDF in semi-suspension, stoker-grate boiler	Steam for urban and industrial heating and cooling; ferrous metals	1000 TPD	51[a]	In shakedown; fully operational in March 1980	Dave Chapman 203 Municipal Bldg. 166 South High St. Akron, Ohio 44308
Albany, N.Y.	City and 10 nearby communities; Smith & Mahoney (designer/project mgr.)	Shredding; magnetic separation; burning in semi-suspension, stoker-grate boiler; nonferrous recovery from boiler ash	RDF, ferrous metals, steam for urban heating and cooling, nonferrous metals	750 TPD	22	Construction completed in March 1980, shakedown to begin in April; steam generating facility operational in 1981	Patrick Mahoney Smith & Mahoney 40 Steuben St. Albany, N.Y. 12207
Ames, Iowa	City; Gibbs, Hill, Durham & Richardson, Inc. (designer)	Baling waste paper, shredding, magnetic separation, air classification, screening, other mechanical separation	Refuse-derived fuel for use by utility, baled paper, ferrous metals, aluminum, other nonferrous metals	200 TPD 50 TPH	6.19[a]	Operational since 1975	Arnold Chantland Dir. Dept. of Public Works City Hall 5th and Kellogg St. Ames, Iowa 50010
Baltimore, Md.[c]	City; EPA	Formerly Landgard[b] process, now modified significantly by Baltimore City; includes shredding, pyrolysis, steam production, water	Steam for use by city utility	600 TPD	30.1	Plant operating 24 hrs./day, 6 days/week	Ed May Baltimore City Pyrolysis Plant 1800 Annapolis Rd. Baltimore, Md. 21230

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Baltimore County, Md.	County; Maryland Environmental Service; Teledyne National (designer/operator)	Shredding; air classification; magnetic separation	RFD; ferrous metals; glass for secondary products; aluminum	600-1500 TPD	8.4	Operational; recovering ferrous metals and producing secondary shredded and pelletized RDF; glass and aluminum recovery operational	Kenneth Cramer Teledyne National 117 Church Lane Cockeysville, Md. 21030
Braintree, Mass.	City (owner/operator); Camp, Dresser & McKee, Inc. (designer)	Mass burning	Steam; producing ½ million lbs/day; selling ½ of steam produced to Art & Leather Co.	250 TPD	2.8	Operational since 1971	Edward Courchene, Supt. Braintree Thermal Waste Reduction Center Ivory Street Braintree, Mass. 02184
Bridgeport, Conn.	Conn. Resources Recovery Authority; Occidental Petroleum Corp. and Combustion Equipment Assoc. (designer/operator)	Shredding; magnetic separation; air classification; froth flotation	Eco-Fuel II® (Powdered fuel) for use in utility boiler; ferrous metals; nonferrous metals; glass	1800 TPD	53[c]	Construction complete; startup has begun; Eco-Fuel II® in production and being test burned at United Illuminating Co.	Ed Kelly, Dir., Corporate Communications Combustion Equipment Assoc. 555 Madison Ave. New York, N.Y. 10022
Chicago, Ill. (Northwest Incinerator)	City; Metcalf & Eddy, Inc. (designer)	Waterwall combustion	Steam for Brach Candy Co., ferrous metals	1600 TPD	23	Operational since 1971; steam delivery expected to be on line in 1980	Emil Nigro Supervising Engineer Bureau of Sanitation Room 704—City Hall Chicago, Ill. 60602
Chicago, Ill. (Southwest Supplementary Fuel Processing Facility)	City; Ralph M. Parsons Company and Consoer, Townsend & Assoc. (designers)	Shredding; air classification; magnetic separation	RDF for use by utility; ferrous metals	1000 TPD	19[d]	Temporarily off-stream to review experience to date and evaluate future operations	(Same as previous listing)
Columbus, Ohio	City; Alden E. Stilson Assoc. (designer)	Shredding; magnetic separation; burning of shredded refuse with supplemental coal in semi-suspension, stoker-grate boiler to produce steam; generation of electricity from steam	Electricity for City customers	2000 TPD	127	Equipment being purchased; site preparation began July 1979; piling begun for foundations; operational in late 1981	Henry Bell, Supt. Div. of Electricity 50 W. Gay St. Columbus, OH 43215
Dade County, Fla.	County; Black Clawson/Parsons & Whittemore, Inc. (designer)	Hydrasposal™ (wet pulping); magnetic and other mechanical separation	Steam for utility to produce electricity; glass; aluminum; ferrous metals	3000 TPD	165[e]	Contracts signed between County, P&W and Fla. Power & Light; pollution control bonds sold by state; construction began April 1979; completion scheduled for April 1981	Dennis Carter Asst. County Manager Room 911 Dade County Courthouse 73 W. Flagler St. Miami, Fla. 33130
Detroit, Mich.	City	Shredding; air classification; magnetic separation; dedicated boilers	Steam and/or electricity for use by Detroit Edison; ferrous metals	3000 TPD	125	Negotiating with Combustion Engineering, Inc., Waste Resources Corp. prior to contract signing; steam to be purchased by Detroit Edison; State of Michigan environmental impact statement being prepared	Michael Brinker Dept. of Public Works City of Detroit City County Bldg., Room 513 Detroit, Mich. 48226

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Duluth, Minn.	Western Lake Superior Sanitary District (operator); Consoer, Townsend & Assoc. (engineer)	Shredding; magnetic separation; air classification; secondary shredding; fluidized bed incineration of RDF and sludge	RDF; ferrous metals; steam for heating and cooling of plant and to run process equipment	400 TPD of MSW; 340 TPD of 20% solids sewage sludge	19	Start-up & shakedown in Spring 1980	John Klaers Western Lake Superior Sanitary Dist. 27th Ave. West & The Waterfront Duluth, Minn. 55806
East Bridgewater, Mass.	City of Brockton and nearby towns; Combustion Equipment Assoc.; East Bridgewater Assoc.	Shredding; air classification; magnetic separation; other mechanical separation	Eco-Fuel II® for industrial boiler; ferrous metals	550 TPD being processed	10-12	Operational since 1977; plant has served as pilot operation for production of Eco-Fuel II®	(Same as Bridgeport, Conn.)
Glen Cove, N.Y.	City (owner/operator); William F. Cosulich and Ernest F.W. Frank (designers)	Mass burning in stoker-fired furnace with vacuum filtered sewage sludge	Steam for electricity for use at sewage plant	225 TPD	32 ($20 M for mass burning unit; $12 M for sewage plant)	Sewage plant and incinerator unit under construction	Mike Grieco Director of Public Works City Hall, Bridge St. Glen Cove, N.Y. 11542
Hampton, Va.	City; NASA Langley Research Center; U.S. Air Force at Langley Field; J.M. Kenith Co. (designer/builder)	Mass burning	Steam for use by NASA Langley Research Center	200 TPD	9.4	Boilers, roofing & siding installed; pumps, motors, & controls being installed	Frank H. Miller, Jr. Dir. of Public Works Hampton, Va. 23669
Harrisburg, Pa.	City; Gannett, Fleming, Corddry and Carpenter, Inc. (designer)	Waterwall combustion; bulky waste shredding (steam driven); magnetic separation; sewage sludge burning	Steam for utility-owned district heating system and for City-owned sludge drying system; ferrous metals	720 TPD	8.3	Operational since Oct. 1972; steam sale to utility began Dec. 1978; sludge drying facility started early 1980	Paul W. Bricker Gannett, Fleming, Corddry and Carpenter, Inc. P.O. Box 1963 Harrisburg, Pa. 17105
Hempstead, N.Y.	Town; Hempstead Resource Recovery Corp. (Div. of Black Clawson/Parsons & Whittemore, Inc.) (owner/operator)	Hydrasposal™ (wet pulping); magnetic and mechanical separation; burning of RDF product in air-swept spout spreader stoker boilers	Electricity from utility-owned turbine generators; color-sorted glass; aluminum; ferrous metals	2000 TPD (150 TPH)	115	In shakedown	D.C. Cullingham V.P. & Gen. Mgr. Hempstead Resource Recovery Corp. P.O. Box 4014 Roosevelt Field Station Garden City East, N.Y. 11530
Lakeland, Fla.	City (operator and joint owner with Orlando Utility Commission); C.T. Main, Inc. (power plant designer); Horner & Shifrin, Inc. (waste processing plant designer)	Shredding; magnetic separation; burning RDF with coal	Steam to produce electricity for use by City of Lakeland and Orlando Utility Commission; ferrous metals	300 TPD	5	Equipment purchased; construction begun; shakedown expected in mid-1981	Claude Hiers Supt. of Industrial Engineering & Business Affairs Box 368 Lakeland, Fla. 33802
Lane County, Ore.	County; Allis-Chalmers Corp. (designer); Western Waste Corp (operator)	Shredding; air classification; magnetic separation	RDF; ferrous metals	500 TPD	2.1	Off stream due to explosion in Nov. 1979; to be operational in mid-1980	Mike Turner Adm. Analyst Lane County Solid Waste Mgt. Div. Environmental Mgt. Dept. 125 East 8th Ave. Eugene, Ore. 97401
Madison, Wis.	City and M.L. Smith Environmental (designer); Madison Gas & Electric Co. (RDF user)	Shredding; magnetic separation; separation of combustibles and non-combustibles; secondary shredding air swept	RDF for use by Madison Gas & Electric Co.; ferrous metals	400 TPD (max.) (200 TPD being processed)	2.5	Process plant & boiler firing facility operational	Gary Boley Div. of Engineering Room 115 City-County Bldg. Madison, Wis. 53709

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Milwaukee, Wis.	City; (to expand to surrounding Milwaukee County areas); Americology Div. of American Can Co. (owner/operator); Bechtel, Inc. (designer)	Shredding; air classification; magnetic and other mechanical separation	RDF for use by utility, bundled paper and corrugated, ferrous metals; aluminum; glassy aggregate	1600 TPD	18 (Plus 4.2 at Wisconsin Electric Power Co.)	Now operational at design capacity, RDF utilization problem at WEPCO due to boiler slagging on coal only, under evaluation; $4.6 million production improvement program held in abeyance pending evaluation	George Mallan Dir. of Operations & Marketing Americology American Can Co. GOP #8 Greenwich, Conn. 06830
Monroe County, N.Y.	County (owner); Raytheon Service Co. (designer)	Shredding; air classification; magnetic & other mechanical separation; froth flotation	RDF for use by utility; ferrous metals; non-ferrous metals; mixed glass	2000 TPD	60.2[1]	Construction complete; startup began Sept. 1979	Howard Christensen Dir. of Solid Waste Department of Public Works 110 Colfax St. Rochester, N.Y. 14606
Nashville, Tenn.	Nashville Thermal Transfer Corp.; I.C. Thomasson & Assoc., Inc. (designer)	Thermal combustion	Steam for urban heating and cooling	400 TPD 7 days per week	24.5	Operational since 1974, recently upgraded two boilers to 530 TPD capacity each	Milton E. Kirkpatr Exec. V.P. & Gen. Mgr. Nashville Thermal Transfer Corp. 110 First Ave. Sou Nashville, Tenn. 37201
Newark, N.J.	City; Combustion Equipment Assoc. and Occidental Petroleum Corp. (designers and operators)	Shredding; air classification; magnetic and other separation	Eco-Fuel II® for use by utility; ferrous metals; aluminum	3000 TPD (in 1000 TPD modules; to serve Newark's 700 TPD and surrounding community)	70 (for 3000 TPD) (initially 1000 TPD with a cost of $25 million including fuel user conversion)	Final contract signed 1977; site preparation began in Dec. 1978	(Same as Bridgep Conn.)
New Orleans, La.	City; Waste Management, Inc. (owner/operator); National Center for Resource Recovery, Inc. (designer/implementer)	Shredding; air classification; magnetic and other mechanical separation	Ferrous metals; aluminum and other non-ferrous metals; glass	700 TPD	9.1[1]	Shredding/landfilling operational, recovering ferrous, aluminum, other nonferrous metals, glass in shakedown	Clifford Scineaux Deputy Director Dept. of Sanitation City Hall New Orleans, La. 70112
Niagara Falls, N.Y.	Hooker Energy Corp. (Hooker Chemicals & Plastics Corp.) (owner/operator)	Shredding; magnetic separation; burning shredded refuse	Steam and electricity for use by company complex; ferrous metals	2200 TPD	74 (appx.)	75% complete, mechanical completion April 1980	James Green Media Relations Hooker Chemical MPO Box 728 Niagara Falls, N.Y. 14302
Norfolk, Va. (U.S. Naval Station)	U.S. Navy (owner); Navy Public Works Center (operator); Metcalf & Eddy, Inc. (designer)	Mass burning in waterwall furnace	Steam (40,000 lbs/hr.) for use by Naval Station	360 TPD (two boilers, operated alternately)	2.2	Operational	Causey Simmons Head, Utilities Dept., Navy Public Works Center Norfolk, Va. 23511
Oceanside, N.Y.	Township of Hempstead (owner/operator); Charles R. Velzy (designer)	Mass burning in waterwall furnaces	Steam (60,000 lbs/hr.) in-plant use for electricity generation	750 TPD	9	Operational since 1965	Al Albanese Supt., Sanitation Township of Hempstead 1600 Merrick Rd. Merrick, N.Y. 115
Orange County, Fla. (Walt Disney World)	U.S. Department of Energy, Idaho Operations Office, Reedy Creek Utilities Co.	Lagging pyrolysis incineration	High temperature water for heating and cooling	100 TPD	11 (appx.)	Demonstration plant, final design complete, groundbreaking scheduled for June 1980	Carl P. Gertz Project Mgr. U.S. Dept. of Energy 550 Second St. Idaho Falls, Idaho 83401

The following localities are either operating or constructing small modular combustion units to produce steam from mass combustion of municipal solid waste:

LOCATION	MANUFACTURER	REPORTED CAPACITY (TPD)	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Auburn, Maine	Consumat	150	3.2	Design contract, funded by DOE, signed; energy use and operator contracts signed; construction began Aug. 1979; startup planned for Nov. 1980	Robert Belz Public Works Auburn City Hall 45 Spring St Auburn, Maine 04210
Blytheville, Ark.	Consumat	75 to be processed	N/A	Temporarily shut down for installation of additional units	Tom Little, Mayor City Hall Blytheville, Ark. 72315
Crossville, Tenn.	Smokatrol	60	1.11	In shakedown; undergoing modifications	Nelson C. Walker Gen. Mgr. Environmental Services Corp. P.O. Box 765 Crossville, Tenn. 38555
Dyersburg, Tenn.	Consumat	100	2	Under construction; startup scheduled in early 1980	Alderman Bob Kirk Colonial Rubber Dyersburg, Tenn. 38024
Genesee Township, Mich.	Consumat	100	2.0	Began operations in Feb. 1980	Hanumanthaiya Marur, P.E. Township Engineer 7244 North Genesee Rd. Genesee, Mich. 48437
Groveton, N.H.	Environmental Control Products	24	N/A	Operational since 1975	Rick Coville Groveton Paper Mill Inc. Groveton, N.H. 03582
Lewisburg, Tenn.	CICO	60	N/A	Under construction; to be in operation in July 1980	John D. Lambert City Manager 505 Ellington Pkwy. Rt. 1 Lewisburg, Tenn. 37091
North Little Rock, Ark.	Consumat	100	1.45	Operational 1976-1979; presently undergoing modifications. City awarded contract to Consumat Systems, Inc., for modifications and long-term operation; scheduled to re-open in March 1980	Mike Butner President U.S. Recycle Corp. P.O. Box 7561 Little Rock, Ark. 72217
Osceola, Ark.	Consumat	50	1.1	Began operations in Jan. 1980	R.E. Prewitt, Mayor City Hall Osceola, Ark. 72370
Pittsfield, Mass.	Vicon Recovery Assoc. (Enercon designed incinerators)	240	6.2[m]	Construction to be completed in Sept. 1980	Joseph J. Domas, Jr. President Vicon Recovery Assoc. P.O. Box 100 Butler Center Butler, N.J. 07405
Salem, Va.	Consumat	100	1.9	Operational in 1979	William Paxton, Jr. City Mgr. P.O. Box 869 Salem, Va. 24153
Siloam Springs, Ark.	Consumat	16	4	Operational since Sept. 1975 (Presently being used as incinerator only)	Al Varney, Dir. Sanitation Dept. 410 North Broadway Siloam Springs, Ark. 72761

LOCATION	KEY PARTICIPANTS	PROCESS	OUTPUT	REPORTED CAPACITY	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Pinellas County, Fla.	County; Florida Power Corp; UOP, Inc.	Mass burning	Electricity; ferrous metals, aluminum and other nonferrous metals recovered after burning	14,000 tons per week	140	Final financial arrangements prior to bond sale; projected to begin construction this year; operational 1983	Don F. Acenbrac Dir. Solid Waste Dept. of Public Works and Utilities Pinellas County 315 Court St. Clearwater, Fla. 33516
Pompano Beach, Fla.	Waste, Management, Inc.; U.S. Dept. of Energy; Jacobs Engineering Co. (designer)	Shredding; air classification; magnetic and other mechanical separation; anaerobic digestion of air classified light fraction with sewage sludge	Methane gas; carbon dioxide	50-100 TPD	3.65	Demonstration plant; operational	Peter J. Ware Proj. Mgr. Waste Management 900 Jorie Blvd. Oak Brook, Ill. 6
Portsmouth, Va. (Norfolk Naval Shipyard)	U.S. Navy (owner); Public Works Dept., Norfolk Naval Shipyard	Mass burning in waterwall furnace	Steam (30,000 lbs/hr) for use by facilities at Naval Shipyard	160 TPD (two-80 TPD boilers; operated alternately)	4.5	Operational since 1976	Pete Cunanan NAVFAC ENG COM Environmental Quality Division Norfolk, Va. 235
Portsmouth, Va. (Southeastern Tidewater Energy Project)	Southeastern Public Service Authority of Va.; Henningson, Durham & Richardson (architect/engineer); Day & Zimmerman (construction manager); Norfolk Naval Shipyard	Shredding; air classification; ferrous & nonferrous metals separation; burning RDF in semi-suspension, stoker-grate boiler	RDF; ferrous metals; nonferrous metals; steam & electricity for Shipyard	2000 TPD	144.9	Design 40% complete; site acquired; Environmental Impact Assessment approved; contract for sale of steam & electricity to Shipyard undergoing approval; construction to begin in early 1981	Durwood S. Curlin Executive Direct Southeastern Tidewater Energy Project 18 Koger Executive Center, Suite Norfolk, Va. 235
San Diego County, Calif.*	County; Occidental Petroleum Corp. (designer/operator)	Shredding; air classification; magnetic and other mechanical separation; froth flotation; pyrolysis	Pyrolytic oil, ferrous and nonferrous metals; glass	200 TPD	EPA—4.2 County—2 Occidental Petroleum 8.3	Demonstration plant; operations suspended after initial testing; further possible funding and modification being considered	John S. Burke, Dep. Dir. Solid Waste Dept. of Sanitation and Flood Cont 5555 Overland A San Diego, Calif. 92123
Saugus, Mass.	Thirteen communities including Saugus and part of northern Boston; RESCO (owner/operator)	Waterwall combustion; magnetic separation	Steam for electrical generation and industrial use; ferrous metals	1200 TPD (two boilers with 600-TPD capacity each)	50	Operational since 1975; expansion being considered	Joseph Ferrante Wheelabrator-Frye, Inc. Liberty Lane Hampton, N.H. 0
Tacoma, Wash.	City (owner/operator); Boeing Engineering (designer)	Shredding; air classification; magnetic separation	RDF, ferrous metals	500 TPD	2.5^	Operational since 1979	Bill Larson, Proj. Mgr. Refuse Utility 740 St. Helens Av Room 304 Tacoma, Wash. 9840
Wilmington, Del.*	Delaware Solid Waste Authority; EPA; Raytheon Service Co. (designer)	Shredding, air classification, magnetic and other mechanical separation, froth flotation; aerobic digestion	Ferrous metals, nonferrous metals, glass, RDF, humus	1000 TPD municipal solid waste co-processed with 350 TPD of 20% solids digested sewage sludge	71.3' 7.4 from EPA OSW, 21.3 from EPA Water Prog., 7.1 from State matching grants; remainder from the Authority through sale of revenue bonds	Groundbreaking Aug. 1979; construction begun; startup expected in Nov. 1981	Pasquale S. Canz Chief Engineer Delaware Solid Waste Authority P.O. Box 981 Dover, Del. 19901

In addition to the systems listed above, projects are underway to recover methane-containing gas mixtures from sanitary landfills which can be purified to pipeline quality:

LOCATION	KEY PARTICIPANTS	OUTPUT: GAS PRODUCED (MILLION FT^3/DAY)	REPORTED CAPITAL COSTS (MILLIONS OF $)	STATUS	CONTACT
Azusa, Calif.	Azusa Land Reclamation Co. (wholly owned subsidiary of the Southwestern Portland Cement Co.)	Low BTU gas	N/A	Began operations in April 1978	Ralph Rufe Southwestern Portland Cement Co. 3055 Wilshire Blvd. Los Angeles, Calif. 90010
Cinnaminson, N.J.	Sanitary Landfill, Inc.; Public Service Electric & Gas Co.; Hoeganaes Corp.	Medium BTU gas; 1.0	N/A	Began operation in 1979; raw landfill gas used in-plant by Hoeganaes Corp.	Ken Matson Public Service Electric & Gas Co. of N.J. 80 Park Place Newark, N.J. 07101
Monterey Park, Calif.	Getty Synthetic Fuels, Inc.; Operating Industries, Inc.; Southern California Gas Co.	High BTU gas; 4.0	N/A	Operational August 1979	Frederick C. Rice Getty Synthetic Fuels, Inc. 2750 Signal Parkway Signal Hill, Calif. 90806
Mountain View, Calif.	City of Mountain View; EPA; Pacific Gas & Electric Co.; Dept. of Energy	High BTU gas; 0.5	0.85	Demonstration plant; currently operating and producing 0.25 MMSCFD of treated gas with a HHV of 750-800 BTU/SCF	Max Blanchet Pacific Gas & Elec. Co. 245 Market St. San Francisco, Calif. 94106
Palos Verdes, Calif.	Getty Synthetic Fuels, Inc.; Los Angeles County Sanitation District; Southern California Gas Co.	High BTU gas; .75	N/A	Operational since June 1975	(same as Monterey Park, Calif.)
Staten Island, N.Y. (Fresh Kills Landfill)	Brooklyn Union Gas Co., Inc.; New York City Resource Recovery Task Force; N.Y. State Energy Research and Development Authority; U.S. Dept. of Energy; Leonard S. Wegman, Inc.		N/A	Burner test of landfill gas in scaled-down furnace completed; construction begun on landfill gas electricity-generating facility to be on-line in summer 1980 for a one-year test, supplying 100 KW of electricity for on-site use	Anthony Giuliani Brooklyn Union Gas Co., Inc. 195 Montague St. Brooklyn, N.Y. 11201
Sun Valley, Calif. (Sheldon-Arleta Landfill Gas Recovery Project)	City of Los Angeles Departments of Public Works and Water & Power	Low BTU gas; 2.8	2.5	Operational	Mike Miller Sanitary Engineer L.A. Bureau of Sanitation Room 1410, City Hall East Los Angeles, Calif. 90012

The following localities reportedly are in advanced planning stages for resource recovery facilities, have issued Requests for Proposals, or are negotiating with bidders/contractors:

Appleton, Wis.
Beverly, Mass.
Calumet City, Ill.
Cincinnati, Ohio
Cuyahoga County, Ohio
Dubuque, Iowa
Gallatin, Tenn.
Hartford, Conn. (and surrounding area)
Honolulu, Hawaii
Martinez, Calif.
Memphis, Tenn.
Menlo Park, Calif.
New York, N.Y.
North Andover, Mass.
North Hempstead, N.Y.
Oklahoma City, Okla.
Oyster Bay, N.Y.
Peabody, Mass.
Rhode Island (state)
St. Paul, Minn.
San Diego, Calif.
San Leandro, Calif.
South/Central Conn.
Springfield, Mass. (and surrounding area)
Springfield, Mo.
Staten Island, N.Y.
Toledo, Ohio
Tulsa, Okla.
Westchester County, N.Y.

Use-Tire Reuse

One of the most serious problems resulting from the increasing number of vehicles traveling our roadways is the accumulation of used tires for which no satisfactory method of reuse or disposal has been implemented. The demand for used rubber is not sufficient to consume more than a fraction of the used tire inventory. Disposal of tires at sanitary land fill sites has not been successful since the tires rise to the surface due to air pockets. Because of the difficulties associated with disposal of tires, most dumps are charging very high prices per ton to accept them.

Recent research conducted by the Coal Research Center of the U.S. Bureau of Mines in Pittsburgh, using an idea originally conceived by scientists of the Firestone Tire & Rubber Company, has shown promising results as a potential solution to the problem of accumulating used tires.

Large quantities of chemicals, oil liquids, gas, and tar have been obtained from discarded tires by heating them in a closed vessel. Tires are fed into the reactor and, as they are heated, they break down. High Btu gas for heat and power is obtained and the liquids are distilled into valuable chemicals.

A series of tests at 500 °C produced 140 gal of liquid oils and 1,500 cubic ft of gas per ton of tires. The gas is comparable in heating value to natural gas. The chemicals obtained from the tires are similar to those produced from coal carbonization (the heating of coal without air), including benzene, toluene, xylene, and naphthas.

These tests indicate that the solution to the problem of discarded tires may be solved in the future. Firestone is currently looking at the economic feasibility of processing tires in this manner.

Until this process is proven economically feasible, continuing investigation is required to determine the feasibility of other methods for breaking tires.

GUIDE TO SCIENTIFIC COMPOSTING

COMPOSTING: WHAT IT IS:

Composting is nature's original way of recycling.

It is the life-saving and perpetuating process by which wastes from plants and other organic material (including animal) are reconverted into a fresh organic matter necessary for the continuation of life.

That fresh organic matter, the end product of composting, is *humus:* a complicated mixture of many compounds coming from the interaction of the organic materials which make up the compost pile and the family of soil micro-organisms which is the living prime mover in the composting process.

These micro-organisms are both "nature's digestive system" and the "life of the soil." That is, they "chew up" the raw organic materials in the compost pile, greatly reducing them in bulk as they break them down into humus.

At the same time, the micro-organisms are making a home in the humus, multiplying prolifically — their dead forms contributing important proteins to the humus, the living ones providing the microbial and chemical processes which facilitate the transference of nutrients to new plant life.

Composting, then, is the on-going natural process by which vegetable and other organic wastes are recycled into humus, a unique organic matter the deprivation of which means the death of the soil and the harm of all living things.

COMPOSTING: HOW WE CAN ENCOURAGE IT:

Like many other biochemical processes, composting can be encouraged if we provide it with an optimum environment in which its many complex transactions can take place quickly and most efficiently.

12.0 The student will demonstrate a knowledge of comparative analysis of resource recovery by describing the advantages and disadvantages in terms of:

12.1 Production with recovered materials, conservation of materials, and conservation of energy.

12.1.1 Visit a local industry that uses solid waste recycling. Find out how long the company has been using recycled material. What changes had to be made in order to accept recycled materials? Find out what percentage of their production is from recycled material. How much virgin material is saved? Find out if it takes more or less energy using recycled material.

12.2 Aesthetic preservation or enhancement.

12.2.1 Contact several local industries that utilize recycled materials. Find out where they obtain their virgin and recycled materials. Make up a chart showing how much less land area is required for solid waste disposal due to recycling. Make up another chart showing how much less land is disturbed because of reduced demand for the virgin materials.

12.3 Environmental controls and protection.

12.3.1 Visit a local landfill site. Talk to the operator and find out what he does to protect the surrounding land, air, and groundwater from pollution.

12.3.2 Visit a local solid waste incinerator. Ask the operator what pollution control features the incinerator has. Do these controls reduce the efficiency of the incinerator or make it more difficult to operate? Do they prevent the operator from burning certain types of refuse?

12.4 Marketing products made from recycled materials.

12.4.1 Visit a local industry which recycles solid waste materials. Find out if the quality of the final product is as good as that made from 100% virgin materials. What is the public's acceptance of items made from recycled material?

12.4.2 Conduct your own survey at a local supermarket or shopping mall. Make a list of products made from recycled materials. Ask people what they think of using items made from recycled materials. Is the quality the same, worse, or better than similar items made from virgin materials?

12.5 Maintaining our present lifestyle.

12.5.1 Using the knowledge of the previous exercises, comment on what effect resource recovery has on your present lifestyle. What do you think your lifestyle would be like today if there were no resource recovery efforts? What would it be like if there were considerably more resource recovery being practiced?

12.6 Economic potentials.

12.6.1 Talk to suppliers and users of recycled materials. Ask them how much it costs to produce one ton of finished product using recycled material and virgin products.

RECYCLING: major source of raw materials

Recycled materials make up important percentages
of the nation's resource base.

Copper 40% | Aluminum 25% | Lead 49% | Zinc 14% | Stainless Steel 30%

Gold 35% | Silver 23% | Paper 20% | Textiles 13%* | Rubber 4%

Based on data from the U.S. Bureau of Mines; U.S. Department of Commerce.

*Based on percentage of textile wastes recovered and recycled for supply to all consuming industries, textile and non-textile.

ALUMINUM

Major Product Applications

- Aircraft, Automobiles, other Vehicles
- Building and Construction
- Containers and Packaging
- Household Appliances and Cookware

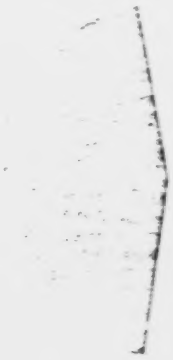
Providing 25%
of Raw Material Supply

COPPER AND BRASS

Major Product Applications

- Automotive Components
- Electrical Equipment
- Household Utensils
- Military Ordnance
- Power Generators
- Tubing
- Wire and Cable

Providing 40%
of Raw Material Supply



LEAD

Major Product Applications

- Ammunition
- Batteries
- Cable Sheathing
- Gasoline Additives
- Printing Type
- Solder

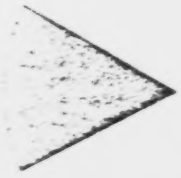
Providing 49%
of Raw Material Supply

ZINC

Major Product Applications

- Brassmaking
- Die-Casts for Automotive and other Industrial and Consumer Uses
- Galvanizing and Coatings
- Oxides and Chemicals

Providing 14% of Raw Material Supply



NICKEL/STAINLESS STEEL

Major Product Applications

- Aerospace
- Automobiles and other Vehicles
- Construction
- Household Appliances and Cutlery
- Machinery, Tools and Instruments
- Shipbuilding

Providing 30% of Raw Material Supply

PRECIOUS METALS

Major Product Applications

- Decorative Ware
- Dental Fittings
- Electrical and Electronic Components
- Jewelry
- Photographic Materials

Providing 35% of Gold Raw Material Supply

Providing 23% of Silver Raw Material Supply

PAPER

Major Product Applications

- Boxes, Containers and Paperboard Packaging
- Insulation and Construction
- Newsprint
- Stationery and Books
- Towels, Tissues, Napkins

Providing 20% of Raw Material Supply

TEXTILES

Major Product Applications

- Apparel, Blankets, Carpeting
- Batting and Padding
- Fine Paper and Currency
- Flock and Filler
- Roofing and Flooring
- Vulcanized Materials
- Wiping Cloths

Representing 13% of Wastes which are Recovered and Recycled by All Industries

RUBBER

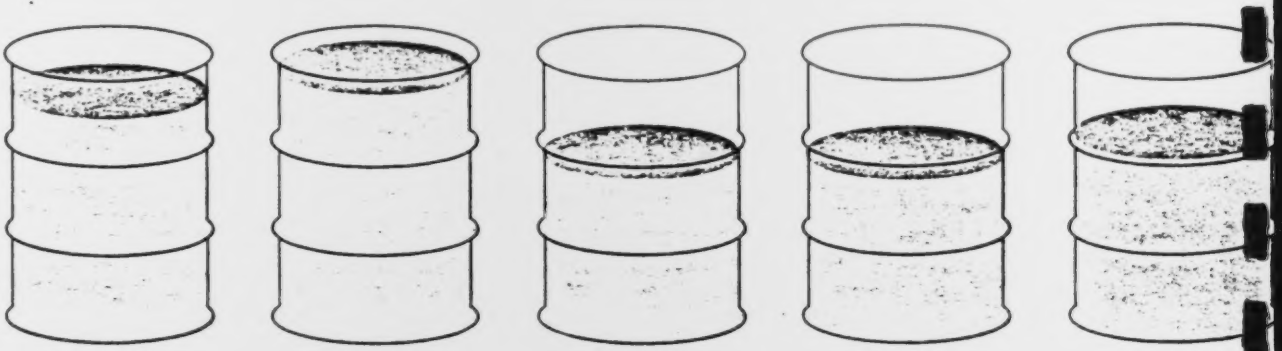
Major Product Applications

- Asphalt Paving
- Hosing and Molded Parts
- New Tires
- Roofing and Siding

Providing 4% of Raw Material Supply

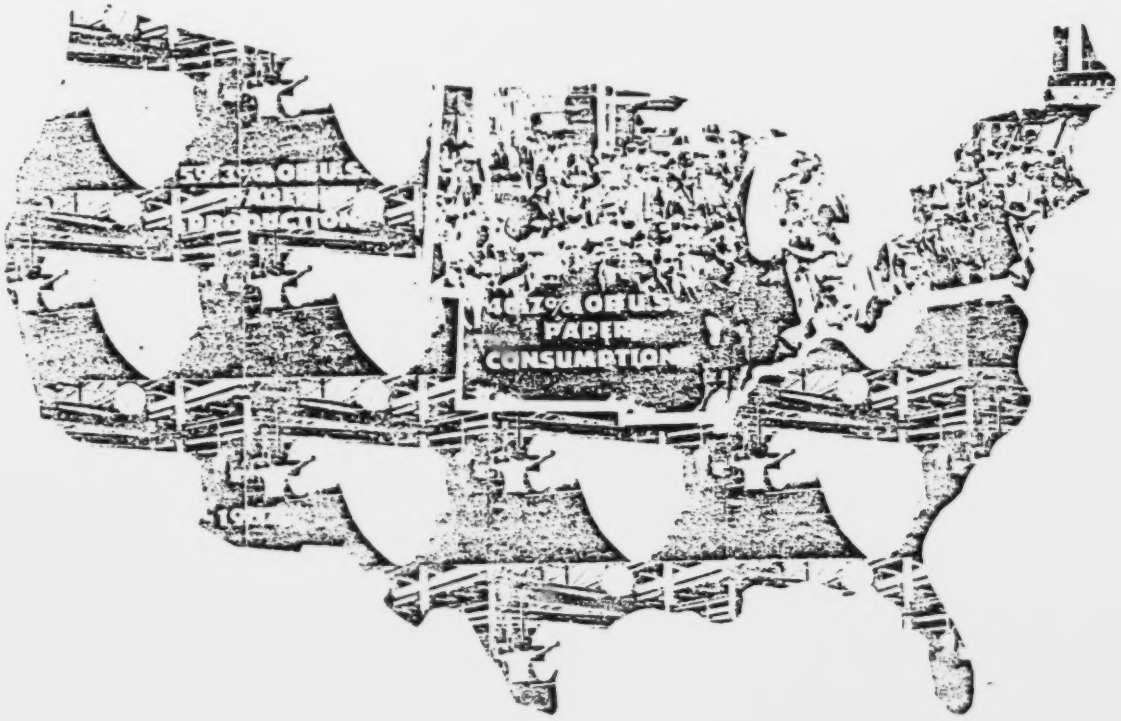
RECYCLED MATERIALS: vital energy-saving assets

The use of recycled materials in manufacturing conserves large quantities of essential energy resources. Here are typical energy savings that result from the utilization of recycled commodities.



Based on data from the U.S. Environmental Protection Agency, Atomic Energy Commission, and other authoritative organizations.

paper production facilities are located away from population centers where waste paper is discarded



RESOURCE CONSERVATION

- **Resource recovery is being implemented primarily because** cities badly need an alternative to land disposal due to local opposition to landfills and lack of available land.

- **Only 7 percent** of the municipal solid waste stream was being recovered as of 1977:
  - Six percent was recovered through source separation, the setting aside of recyclable material at the point of generation. Paper accounts for 90 percent of source-separated material.
  - One percent was converted into energy.

- **Potential recovery of energy** from municipal solid waste in urban areas is equivalent to:
  - 400,000 barrels of oil per day, or
  - Nation's commercial and residential lighting needs, or
  - One-third the flow of the Alaskan pipeline

- **Progress in implementing resource recovery facilities:**

	1972	1978	1985
Number of 1,000 tons-per-day equivalents	2	18	40-70
Population served (millions)	1	9	20-35
Percent of waste stream processed	0.5	3	10-15

- **Percent of solid waste converted to energy by country (1977):**

Denmark	60
Switzerland	40
Netherlands	30
Sweden	30
Germany	20
England	10
United States	1

- **Energy recovery technology is available** to support a significantly greater rate of implementation in this country; however, there is limited commercial experience and, thus, technological risk. **The four types of systems of greatest interest currently are:**
  - Waterwall combustion: the concept has been proven in over 200 plants in Europe and Japan; it is attracting rapidly growing interest here.
  - Refuse-derived fuel: successfully demonstrated in the United States, but market reluctance is slowing implementation.
  - Small modular incinerators: a promising approach to energy recovery suitable for very small communities.
  - Codisposal of sewage sludge and municipal solid waste: the practice is prevalent in Europe and appears to be technically and economically feasible in this country.

- Locations of major U.S. resource recovery facilities:

Refuse-derived fuel

Ames, Iowa
Baltimore County, Md.
Bridgeport, Conn.*
Chicago, Ill.*
Lane County, Oreg.*
Milwaukee, Wis.*
Monroe County, N.Y.*

Small modular incinerators

Blytheville, Ark.
Crossville, Tenn.
Groveton, N.H.
North Little Rock, Ark.
Siloam Springs, Ark.

Waterwall combustion

Akron, Ohio*
Braintree, Mass.*
Chicago, Ill.†
Hempstead, N.Y.*
Nashville, Tenn.*
Niagara Falls, N.Y.*
Norfolk, Va. (USN)
Portsmouth, Va.
Saugus, Mass.

Codisposal

Duluth, Minn.*
Franklin, Ohio
Harrisburg, Penn.*

*Under construction.
†Steam not being sold at present.

- Economics of resource recovery
  - A rule of thumb is that, on the average, resource recovery costs from $8 to $15 a ton, a few dollars more than sanitary landfilling costs. However, resource recovery is competitive with landfilling in some locations, and is implemented out of necessity in others.
  - Typical capital cost for a 1,000-tons-per-day plant is $25 to $50 million.
- Institutional factors related to planning and implementing resource recovery are a major barrier to implementation.
- Source separation accounts for 90 percent of materials recovery from solid waste:
  - Recycling centers number about 3,000.
  - Curbside collection of recyclable materials is practiced in 215 cities (multimaterial - 40 cities; paper only - 175 cities).
  - Curbside newspaper collection may grow to 400 programs by 1985.
  - Recycling programs are concentrated in the northeast and California.
- Municipal waste materials recycling rates (1976):

	Percent
Paper	18
Aluminum cans	25
Ferrous cans	3
Glass containers	1

price comparison survey of beer and soft drinks in refillable and nonrefillable containers

During the past several years numerous pieces of legislation have been introduced at the Federal, State, and local levels that would require a refundable deposit on beer and soft drink containers. In general, such legislation is expected to result in an increased market share for refillable glass bottles as compared to nonrefillable bottles and metal cans.

One of the questions associated with beverage container legislation is the impact that this type of legislation would have on beverage costs. There have been a few comparison price surveys that indicate that beverages in refillable bottles are sold at lower overall prices for the consumer. However, these surveys have tended to concentrate on individual market areas and have generally contained only a limited number of price comparisons. In order to obtain more information on a broader basis, the League of Women Voters (LWV), in conjunction with the U.S. Environmental Protection Agency (EPA), undertood this price survey to compare beverages in refillable bottle with beverages in nonrefillable bottles and cans.

BACKGROUND

The information gathering device was a questionnaire on which the respondents were asked to obtain comparable price data for beverages in refillable and nonrefillable containers. In addition to the price comparison data, the League members were asked to report the number of beverage brands available in refillables and nonrefillables in the store where the price data was obtained. Of the 65 questionnaires mailed to League members, 34 were returned, which is a response rate 52.3 percent. The returned questionnaires were completed between June and August, 1975.

The beverage price questionnaire was also used to collect container price comparisons data on soft drinks in the Washington, D.C., area during May, 1975. A supplementary survey of beer prices was undertaken in August, 1975, in order to obtain a complete survey of beverage prices in the Washington, D.C., area. The results of both of these surveys have been included in this report.

Summary

Beverages in refillable bottles are definitely cheaper for consumers than beverages sold in nonrefillable containers, according to the results of each of the three price comparison surveys in this report.

Consumers in the Washington, D.C., area, for example, could save an average of 4.4 cents per container, or 26 cents per six-pack, if they purchased soft drinks in refillable containers. The purchase of soft drinks in eight-packs would save consumers an average of 63.2 cents, or 7.9 cents per container.

Purchasers of beer could realize savings ranging from 60 cents to $2.00 per case with the purchase of regular beer in refillables in the Washington, D.C. area. They could also economize on their premium beer purchases by buying in refillable bottles. The average potential price savings observed was 55 cents per case with premium beer.

Savings averaging 5 cents per container, or 30 cents per six-pack, were reported by the League members for soft drinks in 7-ounce to 16-ounce refillables. Consumers could economize even more by buying soft drinks in 32-ounce refillable bottles, which were an average 16.8 cents per container less expensive than soft drinks in the same size nonrefillables.

The League members also reported that soft drinks were generally available in refillable containers, but the brand and size selection was considerably less than the selection that was available in nonrefillables. Beer, however, was available in refillable bottles in only a limited number of instances.

Of the surveys taken in the Washington, D.C., metropolitan area, only the beer survey obtained information on the availability of refillables. The data collected showed that in Washington, D.C., 37.5 percent of the stores surveyed carried refillables, while in the surrounding areas of Virginia and Maryland the percentages were 38.4 percent and 20.6 percent respectively. In addition, except for one grocery store chain, which offered beer in six-packs with refillable bottles, beer in refillables was sold only by the case.

fact sheet-12.0

NATIONAL CENTER FOR RESOURCE RECOVERY, INC.

1211 CONNECTICUT AVE., N.W., WASHINGTON, D.C. 20036 (202/223-6154)

Briefs

September 1979

RESOURCE RECOVERY: Lessons to be Learned

In a September 14 keynote address to the Florida Resource Recovery Council's "Resource Recovery in the Sunshine" conference in Orlando, NCRR President Dr. Rocco A. Petrone recalled his days as Apollo launch director at the nearby Kennedy Space Center. In the following excerpts from this speech, Dr. Petrone draws some comparisons between the current state of resource recovery and the developmental years of the space program.

The State of Florida has made many important contributions to the exploration of space. It is impressive that virtually all major U.S. missions into space have started their journey from Florida turf. Today, Florida is gaining well deserved recognition for its pioneering in the field of resource recovery.

The successful first landing of man on the Moon on July 20, 1969, was the culmination of a challenge President John Kennedy set for the nation in May 1961. Meeting that challenge was just the beginning, for what Apollo II and the other missions in that program represented was the demonstration of man's ability to function in space.

The subject of this conference, however, is not the exploration of space, but the exploitation of municipal solid waste through a concept that was only on the horizon 10 years ago. Resource recovery is essentially a product of the 1970's. As we move toward the close of the decade, it can be instructive to set this movement in some kind of perspective.

Significant strides have been made in Florida toward implementing recovery systems. These range from the growing newspaper collection programs to the large energy and materials recovery systems for Dade County and Pinellas County. Faced with the usual urban problems of finding waste disposal sites and attempting to meet increasingly stringent environmental regulations - plus the localized situation of high water tables - Florida planners and decision makers have opted for innovative solutions. They are to be commended for having the vision and courage to pioneer in finding definitive solutions to this age-old problem - the proper disposal of our residuals.

The State of Florida has been fortunate in having had the guidance of the Resource Recovery Council in the recovery planning processes. That Florida has become one of the most progressive states in the field of resource recovery is a tribute to the Council's will and commitment, and to the individual communities, local industries and utilities and the State government.

Since Florida has played decisively key roles in both the space program and resource recovery and since I have been fortunate to have participated in both, I would like to draw some parallels between the two.

First, both programs are responses to public interests, needs and concerns. Both require a mix of government and private sector participants to succeed. Both are mission oriented, demanding careful program definition, planning and implementation. And both involve the application of new technology and skilled management. At this point, the similarities end.

Space exploration responds to a broad range of scientific, engineering, political and nationalistic challenges. Resource recovery responds, basically, to the narrow but pressing needs of a local jurisdiction to solve waste disposal problems. There is only one national space program, with many diverse elements and projects. There are, however, as many resource recovery projects as there are communities with severe disposal problems. There is no overall national program to tie the various projects together.

Let's look at these challenges, using the Apollo period of development in the 1960's and the resource recovery movement in the 1970's. Apollo was carried out as national policy, on a national level, and with a national commitment and the necessary funding. While there has been extensive national rhetoric in favor of resource recovery, projects continue - for the most part - to be local in orientation, implementation and funding. Apollo enjoyed "up-front" federal funding, while resource recovery must basically rely on local financing to build and operate facilities. For this reason, available funds are extremely limited to support any research and development efforts. Unfortunately, this is an area that desperately needs innovation.

Apollo appeared as (and in many respects was) a vastly complicated and massive undertaking. The concept was bold, its execution demanding. And it was able to build on previous efforts. The roots of the program extended back many years to the work of individuals in many nations to understand and formulate the basic laws of science and engineering: 60 years of experience in aeronautics...35 years in liquid rocketry...knowledge gained over the years in materials development and manufacturing...and advancements in guidance and navigation, computers and electronics, and just about every discipline in science, engineering and medicine.

By early 1961, man and machinery had already flown to the fringes of space. The complexity of the Apollo program was in pulling together all this knowledge, the management systems and the technology in order to meet the demanding national goal of extending manned space flight to the surface of the moon before the decade ended.

In contrast, resource recovery at first seemed to many to be a simple undertaking. The idea was "merely" to separate out energy products and recyclable materials from solid waste. And, in so doing, less would remain for disposal; the use of recovered commodities would save virgin materials and fossil fuels.

Attempting to carry out resource recovery, however, has proven to be anything but simple. In the first place, we have found that the daily solid waste "stream" composition and characteristics change by the day of the week, season of the year and by weather conditions. It has been difficult to separate cleanly the various recoverable products so that specifications for marketing can be met; and, the equipment and facilities required are more complex and expensive than envisioned.

These realities could only be uncovered by actually applying machines and recovery processes to municipal solid waste. This experience can be gained only by doing, no different, really, from what we faced in the early days of the space program. Fortunately, the research, development and demonstration activities with recovery systems are now providing the foundations on which to plan and build.

More complicated are the array of local problems which surface when attempting to plan and manage resource recovery projects. Many people experienced in resource recovery are well aware of the legal, financial, marketing and political frustrations that can befall a project. Reassuring, however, is the fact that we do benefit from these experiences. The lessons learned from the projects in Dade County, Hempstead, N.Y., New Orleans, Milwaukee and elsewhere are invaluable for more efficient project planning and execution in other cities.

Again, in comparison, the Apollo Program was ambitious and demanding, but the path was essentially straight. The path of resource recovery, on the other hand, has been winding and tortuous. Despite this, much substantive progress has been recorded in the past nine years.

Whereas there were no facilities to recover energy and materials from municipal solid waste in this country at the beginning of the decade, there are now some two dozen plants either operating, in shakedown or under construction. The combined processing capacity of these plants will be more than seven million tons of municipal solid waste per year. And this is in addition to the 9 to 10 million tons of recyclables reclaimed through source separation programs.

Depending on one's outlook, the progress of resource recovery can be viewed from either of two extremes: (1) that we have come a long way toward advancing the institutional and technical systems to tap solid waste for energy and materials, or (2) that we have a long way to go before resource recovery is widely practiced in this country.

My view is that a firm foundation has been established for resource recovery in the 1970's. A technological base has been laid. The basic concept has been carried to the point of near operational status. And, like the developed capability of the space program, it is up to us to decide how and where to apply it... and how fast.

There is really no choice but to proceed at all deliberate speed. Solid waste disposal can only become more costly and difficult as we elevate our environmental standards. Further, the demands for energy and materials conservation can only make the recovery approach more needed and, consequently, attractive.

Florida is one of several states which have been on the leading edge of recovery progress. While these states will be the primary beneficiaries of their respective efforts, other states - and their communities - can benefit from their leadership to establish recovery projects that meet particular needs.

As we recognize the advent of "Resource Recovery in the Sunshine," it is appropriate to single out the contributions of the Resource Recovery Council as it completes its program as chartered by the Florida State Legislature.

# # #

13.0 The student will demonstrate a knowledge of the institutional and governmental influences by:

13.1 Summarizing current Florida environmental control regulations related to solid waste.

13.1.1 Study the Florida Environmental Control Regulation related to solid waste and prepare a poster illustrating a law. The intent of the poster will be to encourage public compliance.

13.2 Discussing the question of ownership of municipal solid waste.

13.2.1 Prepare a debate and discussion panel on the subject "who owns refuse". Two students take one point of view, such as that of the mayor, the private trash collector, the scrap handler, the highway commissioner, the manufacturer, etc.

13.3 Discussing advantages and disadvantages of providing similar tax and tarriff incentives for recycling as exists for production and transportation of virgin materials.

13.3.1 Visit a leader or spokesman for the local members of the material recycling industry. Discuss with him state and federal tax policies and freight rates affecting his competition with virgin ore and other nonrecycled materials. Prepare a presentation to the class members roleplaying as the state legislators on behalf of the recycling industry to increase incentives for recycling.

13.4 Discussing their relationship to research and development of new equipment and techniques for resource recovery.

13.4.1 Investigate all the Florida college and university curriculum catalogs in the library and prepare a listing of all courses related to resource recovery. Contact your local community college to find out what curriculum would include courses on resource recovery if they were offered.

13.4.2 Contact a governmental agency (such as the Environmental Protection Agency) and find out how much money is being spent on resource recovery research and development. How much is the U.S. government funding? How much is private industry funding?

13.5 Discussing public information and educational programs for consumers, industries, and materials handlers.

13.5.1 Interview persons vocationally involved in resource recovery in your community to determine if they feel a need for continuing education courses for themselves, their employees, or would they be interested in presenting a short course or seminar to interested groups in the community.

13.6 Describing pros and cons of specific resource recovery legislation being tested around the country such as: litter control, bottle bills, etc.

13.6.1 Draft a sample bill for your county commissioners or state representatives on an aspect of resource recovery which you feel should be mandatory and not optional in your county or throughout Florida.

13.6.2 Contact your local senators and representatives at both the state and federal levels. Find out about pending legislation concerning resource recovery. Ask them whether they support or oppose each bill and why. Prepare a chart showing how your elected representatives stand on each bill and, on the same chart, whether or not you agree with his stand and why. Bring it to class and discuss it among your classmates.

13.6.3 Prepare a chart or series of charts showing how far along your community is concerning resource recovery. Are business, industry, government,,and the local residents doing all that they can? Why not? List the major obstacles to utilizing our solid wastes to a greater extent. Divide them into three categories: technical, scoial, and political. Which problems are the most difficult to resolve? List ways that you and your classmates can work toward resolving them.

Florida's Resource Recovery Council

In 1974, the Florida legislature created the Resource Recovery Council to promote and encourage resource recovery throughout the state. The Council was also charged to assist the Department of Environmental Regulation to develop the necessary regulations. Members of the Council were appointed and it began operating in January 1975. Through the "sunset" provisions of the legislation, the Resource Recovery Council was terminated Sept. 30, 1979.

During its more than four and a half years of operation, this unique organization helped in planning, coordinating, educating and stimulating interest in applying resource recovery to local solid waste disposal problems. The chairman was Richard Simmons, who is city manager of West Palm Beach. Franchot Buhler served as executive director. *NCRR Bulletin* asked Mr. Buhler if he would describe the brief but significant history of the Council and the advent of resource recovery in Florida.

By FRANCHOT BUHLER

When someone asks what it takes to have a strong state resource recovery program, the answer frequently given is "money, money and money." While I won't argue with this answer, I must say that we never had much money for the Florida resource recovery program. We had to do what we could with landmark enabling legislation and whatever promotion and support we could muster.

We had the advantage, however, of inheriting basically good legislation, which gave the Department of Environmental Regulation (DER) the primary responsibility for developing a state-wide program to deal with mounting waste disposal problems in Florida's rapidly growing urban areas. This legislation also required the DER to permit all solid waste handling facilities, to adopt administrative regulations for facility operations, and to adopt guidelines for the development of local solid waste/resource recovery plans.

The Florida Resource Recovery and Management Act of 1974 could be described as a "little Resource Conservation and Recovery Act," because it contained area-wide planning features similar to RCRA. But more fundamentally, it gradually moved local operations away from open dumping and other improper disposal practices. These improvements in disposal operations resulted in disposal costs that more accurately reflected the true cost; *e.g.*, the total cost of disposal.

Under Florida law, the legislature also created a 13-member Resource Recovery Council (RRC) to aid DER in developing the state program and its regulations. The nine members appointed by the governor represented local governments, environmental groups, business and industry, professional engineering, universities, and the general public. Two Florida state senators and two representatives also served on the RRC.

Although the Florida law required solid waste planning, it did not mandate resource recovery construction. It charged the RRC to designate the areas that should be required to address the feasibility of resource recovery in their local plans. But the questions of *what type* of recovery process and *when* the system should be built were matters for local determination. In short, the legislation strongly encouraged resource recovery, especially energy recovery; but is accorded much latitude to local governments in the implementation of local plans.

"Legislation strongly encouraged resource recovery, especially energy recovery."

The legislation did contain some questionable provisions, such as extremely tight deadlines. Without modification, widespread opposition to the state resource recovery program would have emerged. The RRC set itself to the task of devising the state policies and regulations that would improve disposal practices, encourage resource recovery, and be acceptable to both local officials and the legislature.

The impact of the RRC on the state solid waste resource recovery program was accomplished in three ways: through amendments to existing state statutes, through new legislation, and through recommended changes or additions to the state's solid waste regulations. Some examples:

- **Planning time frame and deadlines**—Legislation originally called for adoption of the state program—including guidelines for local plans—within one year, and submission of local plans within two years. This was unrealistic for two reasons: the burden it placed on local government budgets, and the state-of-the-art for resource recovery in 1974-76. RRC amendments extended the time frame for developing local plans and removed conflicts with other state requirements for local, comprehensive planning.
- **City-county coordination**—Original enabling legislation would have created over 500 city and county plans, resulting in the lowest aggregation of waste volumes. RRC amendments encouraged a state-wide trend toward county-wide plans via county-wide authorities, county solid waste agencies, or cooperative inter-local agreements.
- **Recognition of private sector**—RRC inserted language in state regulations urging use of the private sector in project planning and in operations, and discouraging the creation of public recycling projects which would duplicate and compete with existing private operations.
- **State bond-loan program**—Early in its existence, the RRC addressed the matter of financing large-scale resource recovery projects. Several financial analysts and representatives of investment banking firms participated in the discussions. As a result, amendments were drafted and passed, making it possible to use state pollution control bonds to finance resource recovery facilities. On the Dade County project, for example, state general obligation bonds were issued and the proceeds loaned to the county. The interest rate on the state's AA bonds was 5.68 percent. At about the same time, municipal resource recovery revenue bonds were issued for a project in another state. The interest rate, by comparison, was eight percent.
- **Sales tax exemptions**—RRC-sponsored legislation established a state sales tax exemption for resource recovery facilities and equipment owned or operated in behalf of local governments. Traditionally, in an architect and engineering type project construction, a city or county makes equipment purchases which are exempt from state sales tax. But under a full-service contract for design, construction and operation—the type commonly used in large-scale recovery projects—actual procurement is handled by the private sector which does not enjoy the tax exemption and, therefore, must pass the cost along. The project impact of this seemingly cosmetic measure is quite significant. The exemption produced savings of almost $2 million on the Dade County project and about $1 million on the Pinellas County project.

"We simply rejected the idea that resource recovery was a gold mine; we looked at it from a business basis."

The RRC's posture on several issues was a gauged reaction to the prevailing winds of the mid-70's, when resource recovery enjoyed the glow of rosy promises and blue-sky projections. We simply rejected the idea that resource recovery was a gold mine; we looked at it from a business basis. The RRC consistently opposed state grant assistance for project construction costs. State pollution control bonds and local general obligation or revenue bonds are better methods of capital financing than a state grant program. The RRC felt resource recovery facilities should be built because of compelling project economics, not merely because state subsidies were available. The RRC did not ignore, however, the need for financial assistance in the early stages of project planning and implementation. One of its last recommendations was for enactment of a state revolving loan fund to assist with "up front" project costs.

Florida Recovery Activities

In 1974, only a couple of Florida localities were seriously considering resource recovery. Today, Dade and Pinellas Counties are implementing large-scale energy recovery projects. Major feasibility work is nearing completion in Tampa-Hillsborough County. Two steam projects using wastes generated on military bases are under construction at Jacksonville and Mayport Naval Stations. A federally-supported, proof-of-concept facility owned by Waste Management, Inc., is operating on a test basis in Pompano Beach. Almost two dozen resource recovery feasibility studies have been conducted in Florida since 1975. Four Florida localities (Broward County, Daytona Beach, Escambia County, and Tampa-Hillsborough) are beginning additional technical evaluations under partial grants from the U.S. Environmental Protection Agency as part of President Carter's Urban Program.

Another Florida city (Orlando) and a private firm (Scientific Energy Engineering, Inc., of Jacksonville) have received grants from the U.S. Department of Energy. Five counties (Alachua, Lee, Seminole, Volusia and Palm Beach County Solid Waste Authority) have recently evaluated resource recovery options. Walt Disney World and Orange County are planning a demonstration project. A compost project is nearing the end of construction in Key West; another is being planned in Dade County. Fourteen communities (such as Boca Raton, Deerfield Beach, Madeira Beach, North Palm Beach, Oakland Park, Temple Terrace and West Palm Beach) are operating source separation programs where residents separate and save newspapers for recycling.

Another example was the state pilot project which the RRC was required to recommend. Members felt it was unwise and unnecessary. They questioned the management capability of the state environmental agency to undertake such a project. They viewed the selection of a technology for the pilot as analogous to reinventing the wheel, since demonstrations of numerous technologies were already being built or planned. "If we build a pilot plant," said one member, "five years from now it will be the only project in the state because everyone will wait to see how it works out before they do anything." The RRC voted to encourage all types of resource recovery throughout the state instead of pouring all the state's resources into a single project. Today, among those localities seriously pursuing resource recovery, three are areas where local officials told me their communities would never go to resource recovery unless and until the state built, operated and paid for a successful resource recovery plant.

The RRC also focused attention on key aspects of project planning. The best place to begin, it was felt, was on the "demand" side; *i.e.*, where could the energy produced from refuse be used? The RRC commissioned a state-wide market study to evaluate potential markets for energy conversion. The oil embargo and Florida's dependence upon imported oil supplies made the impact of energy recovery from urban wastes financially attractive. Furthermore, Florida's peninsular economy of tourism and agriculture offered a low industrial profile for materials recovery compared to other regions. The market evaluation spotlighted the critical importance of market identification in resource recovery.

In a related effort, the Council gave much needed attention to waste generation and composition. All solid waste characterization studies performed in the state between 1970 and 1975 were gathered and analyzed. The wide variations in sampling procedures and composition estimates suggested the need for more standardized procedures. The cone and quartering method, developed in the mineral processing industry, was used on a test basis in conjunction with two local jurisdictions and the U.S. Bureau of Mines. The resulting publications have been used by several engineering firms in an effort to perfect more reliable procedures for waste stream analysis in project planning.

Looking back, the thing I remember most is that it almost did not happen. Soon after I moved to Florida, the entire appropriation for the RRC was deleted in subcommittee, then restored that afternoon by a legislative Council member. Resource recovery in Florida—like resource recovery anywhere else—frequently hung by a thread.

In conclusion, the biggest contributor to resource recovery in Florida has been the dual economic impact of rising disposal costs and significantly higher energy costs. State legislation—with a strong resource recovery emphasis and the promotional efforts of a state-wide council—helped, but only because the need for disposal alternatives and the demand for alternate energy sources was driving most project decisions.

"The biggest contributor to resource recovery in Florida has been the dual economic impact of rising disposal costs and significantly higher energy costs."

EPA'S TECHNICAL ASSISTANCE PROGRAM

By RANDOLPH L. CHRISMON

The Resource Conservation and Recovery Act (RCRA) of 1976 provides for ". . . technical and financial assistance for the development of management plans and facilities for the recovery of energy and other resources from discarded materials and for the safe disposal of discarded materials. . . ." Section 2003 of the Act requires that: "The Administrator [of the U.S. Environmental Protection Agency] shall provide teams of personnel, including Federal, State, and local employees or contractors to provide State and local governments upon request with technical assistance on solid waste management, resource recovery, and resource conservation. Such teams shall include technical, marketing, financial, and institutional specialists, and the services of such teams shall be provided without charge to States or local governments."[1]

Following the RCRA mandate, the Environmental Protection Agency (EPA) initiated the Resource Recovery and Conservation Panels Program—better known as the Technical Assistance (TA) Panels Program—to aid state and local governments with their waste management and resource recovery problems. Regional EPA staff, regional consultants (panels) and "peer matches" are the mechanisms used to provide this assistance.

The TA Panels Program defines the difficulties inherent in implementing acceptable waste management activities, suggests and develops a variety of alternatives, and advises responsible jurisdictions as to the kinds of experiences and qualifications a contractor or in-house personnel should bring to the task of implementation. In addition, TA Panels of experts in the field can assist in the preparation of a request for proposals (RFP), assist in evaluation of the responses to an RFP, review the outputs of consultants under contract, and help develop equipment specifications. Thus, the role of the TA Panels Program is to provide sound, unbiased advice, and to act as a catalyst in the development and implementation of environmentally sound waste management practices.

TA Panels Program activities are limited, however, in that EPA and its contractors are not to participate in the decision-making process of a client community. Furthermore, the panels should not act as architects, architectural engineers, design consultants, or financial consultants. It is not intended that the program supplant locally available consultants. The program should only fill the void where consultants lack the required expertise or are not readily available.

"The role of the Technical Assistance Panels Program is to provide sound, unbiased advice, and to act as a catalyst in the development and implementation of environmentally sound waste management practices."

The Technical Assistance Panels Program was formally initiated on Jan. 1, 1978. Prior to that time, technical assistance was available through EPA headquarters in Washington, D.C. Between passage of RCRA and September 1978 three consultants—previously under contract to EPA—were available to provide technical assistance in resource recovery only. This interim situation enabled assistance to be provided while the formal organization of the TA Panels Program was being developed.

In Spring 1978, a request for proposals to hire 10 consultants to provide technical assistance on a regional basis was issued. The first contract was awarded in June 1978, with the bulk awarded in September 1978. The panels program, therefore, was not fully operational until the beginning of the 1979 fiscal year. Through September 1978, however, 172 requests for technical assistance had been answered.[1]

Current Organization and Operation

The current organization of the TA Panels Program reflects EPA's belief that the program should be flexible, responsive and timely. In order to meet the Agency's criteria, it was decided to organize TA Panels on a regional basis.

The original RFP, issued by EPA in March 1978, called for 10 consultants with expertise in technical, financial, economic, marketing, legal and institutional aspects of waste management. These primary subject areas include resource recovery, hazardous waste management, landfilling, waste reduction, collection and general planning.

Contracts with eight consultants were issued with two contractors having responsibility for two regions each. Because of the very large breadth of experience and knowledge required, most consultants have subcontractors with expertise in specific areas.

The program is organized to provide each region with a known consultant and subcontractors. Flexibility is ensured by the broad range of experience

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Table I

Sequence of Events in Providing Technical Assistance

A. Pre Phase I

1. Prospective client encounters problem in current waste management activity.
2. In searching for information, client learns of TA Panels Program.
3. Client contacts regional office project officer for details.
4. Client sends formal letter of request signed by appropriate authority in community.

B. Phase I

1. Regional project officer establishes priority of request.
2. Project officer issues Task Order initiating Phase I activity.
3. Site is visited by consultant and/or sub-contractor and EPA representative.
4. Phase I trip report issued and Scope of Work for Phase II developed.
5. Project officer forwards Scope of Work and Memorandum of Concurrence to EPA headquarters.

C. Phase II

1. Technical Assistance Panels Program staff checks Scope of Work to ensure compliance with policy.
2. Scope of Work forwarded to Office of Solid Waste for approval of disbursement.
3. Scope of Work forwarded to Contract Management Division where details of work are incorporated into Directive of Work (DOW).
4. Consultant undertakes tasks assigned in DOW.
5. Upon completion of assignment, consultant writes final report and sends five copies to regional office.
6. Project officer signs off on DOW and forwards final report to client.

available, including EPA regional and headquarters staff. Responsiveness and timeliness are ensured by managing the program on the regional level rather than through EPA headquarters, although headquarters does maintain oversight or supervisory responsibility. In this way, requests are handled by the regional project officer who is closer to the situation, more readily accessible, and familiar with conditions in the area.

Table I shows a generalized outline of the procedures and sequence of events in rendering technical assistance. Phase I begins when the project officer receives a formal letter of request, signed by the responsible authority, from the prospective client. Phase I ends when a trip report is submitted to the Regional Office and forwarded to the client.

"Resource Recovery still predominates as the area of technical assistance most requested."

The purpose of the Phase I activities is to bring together a Technical Assistance Panel, made up of the regional consultant or his subcontractor and a representative of the EPA regional office. The TA Panel's objective is to define the parameters of the client's waste management problem. If the problem is resolvable within a suggested 40 man-hour limitation, the TA Panel will make specific recommendations.

Most problems are of such complexity that effort greater than a Phase I site visit is required. In these cases, Phase I allows the panel to gain first-hand knowledge of the situations and the principals. With this knowledge, the project officer and the consultant can develop a Scope of Work for Phase II activities.

Phase II activities are designed to provide the detailed assistance required to answer the questions developed during Phase I. Generally, several site visits and meetings with personnel from the client community take place. The consultant may undertake various studies or review studies and proposals made by private consultants under contract to the client.

The final output of the Technical Assistance Panels Program is a report. For Phase I efforts that do not go into Phase II, the final report is the trip report. For Phase II efforts, the final report is a summary of the activities that took place and the findings and recommendations of the TA team. In either case, the report is sent to the project officer, who forwards the approved report to the client. This action closes out the project.

Peer Match Program

The Peer Match Program is another aspect of the TA Panels Program. In some instances, the use of consultants is not appropriate. A community may face problems which have been encountered and resolved elsewhere, or a client may be interested in a piece of equipment or a system which is operational in another community. In such cases, the most effective form of technical assistance may be direct communication between "peers" in the two communities.

The Peer Match Program provides travel expenses for peers to travel from one community to the other. Thus, an experienced official from a community which has already solved a similar waste management problem can be funded to travel to the client community to make a presentation, or a client interested in a particular waste management program or system can obtain funds to travel to a community where a similar program or

Table II

Sequence of Events in Providing a Peer Match

1. Client sends letter of request signed by appropriate authority.
2. Request specifies peer match, or project officer decides that peer match is best resource.
3. Project officer approves and forwards request to EPA headquarters.
4. EPA headquarters forwards request to Solid Waste Interest Group.
5. SWIG makes arrangements for peer match, travel and accommodations.
6. Peer match takes place.
7. After completion of peer match, peer fills in evaluation and reimbursement form and forwards to SWIG.
8. SWIG forwards evaluation to EPA headquarters.

Technical Assistance

system is in use. The effect of the Peer Match Program is promotion of intercommunity communication and avoidance of duplicative efforts.

Table II is a generalized outline of activities in obtaining a Peer Match. As part of the TA Panels Program, grants are awarded to several nonprofit Solid Waste Interest Groups (SWIGS). These groups manage the Peer Match Program by selecting the communities and the peers which seem most appropriate. The SWIG then disburses the funds for travel and expenses. The SWIGS managing the Peer Match Program are listed in **Table III.**

A peer match begins in the same manner as other requests for technical assistance. The client can request a peer match, or the EPA project officer may decide that a peer match is the most appropriate resource to bring to the client. In either case, the project officer must approve the itinerary. The project officer then approves and forwards the request to EPA headquarters.

The headquarters staff passes the request along to the appropriate SWIG. The SWIG is responsible for contacting the peers involved, making the travel arrangements, and disbursing the necessary funds from their grant.

Fiscal Year 1979 Activities

Table IV presents a breakdown of TA activities for the first nine months of Fiscal Year 1979. Resource Recovery still predominates as the area of technical assistance most requested. The 83 requests for resource recovery represent 41 percent of all the requests for technical assistance. Requests for assistance with land disposal constitute 19 percent of the total; hazardous waste, 15 percent; general planning, 12 percent; collection, 8 percent; and "other," 5 percent. Of the total requests accepted, 29 percent resulted in peer matches.

"All levels of government, from small rural towns to state and federal agencies, are eligible for technical assistance."

Eighty-three percent of the requests were accepted, 15 percent were still pending, and approximately 2 percent were rejected. These figures do not represent the total for FY 1979, since an accounting of the last three months of the fiscal year has not yet been made.

Table V is presented for the convenience of those communities interested in obtaining technical assistance from

Table III
Solid Waste Interest Groups Managing Peer Match Program

American Public Works Assn.
1776 Massachusetts Ave., N.W.
Washington, D.C. 20036
(202) 833-1494

Government Refuse Collection and Disposal Assn.
Public Works Solid Waste Division
Portsmouth, Va. 23704
(804) 393-8663

International City Management Assn.
1140 Connecticut Ave., N.W.
Washington, D.C. 20036
(202) 828-3615

National Assn. of Counties
1735 New York Ave., N.W.
Washington, D.C. 20006
(202) 785-9577

National Assn. of Regional Councils
1700 K St., N.W.
Washington, D.C. 20006
(202) 457-0710

National Council of State Legislatures
1405 Curtis St.
23rd Floor
Denver, Colo. 80202
(303) 623-6600

National Governors' Assn.
444 N. Capitol St.
Washington, D.C. 20001
(202) 624-5375

National League of Cities
1620 Eye St., N.W.
Washington, D.C. 20006
(202) 293-7175

Table IV
Breakdown of Requests by Regions FY '79

Region	Requests	Accepted	Rejected	Pending	PM*	HAZ	LD	RR	COL	GP	O
1	27	15	1	11	6	5	5	13	1	3	0
2	20	18	0	2	4	5	5	7	1	2	0
3	10	9	0	1	1	1	2	3	4	0	0
4	13	13	0	0	6	2	0	6	3	0	2
5	29	25	1	3	10	4	8	14	2	1	0
6	21	18	1	2	4	2	3	10	1	5	0
7	10	9	0	1	1	0	3	5	1	1	0
8	43	40	0	3	5	7	7	12	2	7	8
9	15	10	1	4	5	3	2	6	0	3	1
10	14	10	1	3	6	0	3	7	1	3	0
Totals	202	167	5	30	48	29	38	83	16	25	11

*Abbreviations: PM Peer Match
HAZ Hazardous
LD Land Disposal
RR Resource Recovery (incl. source separation)
COL Collection
GP General Planning
O Other

the U.S. EPA. The table lists each EPA Region, the states included in each individual region, and the regional project officer responsible for technical assistance activity.

All levels of government, from small rural towns to state and federal agencies, are eligible for technical assistance. In order to obtain assistance, the responsible authority must make a formal request in writing to the EPA regional project officer. Either the project officer or a member of his staff is also available by phone to answer questions about the program.

Due to budgetary constraints, not all requests for technical assistance can be accepted. Where there are serious solid waste management problems, however, such as hazardous waste, efforts will be made to hold the request until funds are available, or arrange priorities so that the most serious problems can be handled first.

"It is estimated that the Technical Assistance Panels Program can significantly reduce the time usually required to implement sound waste management programs."

Conclusion

The Technical Assistance Panels Program is performing a useful and needed service. Based on an inhouse evaluation, it is estimated that the TA Panels Program can significantly reduce the time usually required to implement sound waste management programs. This is particularly true in those communities where solid waste planning has been done on an ad hoc basis. In such cases, the TA project pulls together all the information in the community, fills in the significant available gaps and delivers a complete and concise report to the decision-maker. Thus, the TA report serves as a focal point upon which further planning and activitiy can be coordinated.

Adams County, Colo., and Auburn, Maine, are examples of the benefits to be derived from technical assistance. Adams County was experiencing an extremely dangerous landfill methane gas migration problem. Two men had died due to an explosion caused by an ac-

Table V
EPA Regions and Technical Assistance Panels Project Officers

Region/States	Project Officer
Region 1 Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont	Conrad Desrosiers EPA - Region 1 John F. Kennedy Building Boston, MA 02203 Tel: (FTS) 223-5775 (617) 223-5775
Region 2 New Jersey, New York, Puerto Rico, Virgin Islands	Garrett Smith EPA - Region 2 26 Federal Plaza New York, NY 10007 Tel: (FTS) 264-0503 (212) 264-0503
Region 3 Delaware, Maryland, Pennsylvania, Virginia, West Virginia	Bill Schremp EPA - Region 3 6th & Walnut Sts. Philadelphia, PA 19106 Tel: (FTS) 597-0982 (215) 597-0982
Region 4 Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee	Elmer Cleveland EPA - Region 4 345 Courtland St., N.E. Atlanta, GA 30308 Tel: (FTS) 257-3016 (404) 257-3016
Region 5 Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin	Art Kawatachi EPA - Region 5 230 S. Dearborn St. Chicago, IL 60604 Tel: (FTS) 353-2197 (312) 353-2197
Region 6 Arkansas, Louisiana, New Mexico, Oklahoma, Texas	Tom Clark EPA - Region 6 1201 Elm St. Dallas, TX 75270 Tel: (FTS) 729-2645 (214) 767-2645
Region 7 Iowa, Kansas, Missouri, Nebraska	Tom Buechler EPA - Region 7 324 E. 11th St. Kansas City, MO 64106 Tel: (FTS) 758-3307 (816) 374-3307
Region 8 Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming	Gary Morgan EPA - Region 8 1860 Lincoln St. Denver, CO 80203 Tel: (FTS) 327-2221 (303) 837-2221
Region 9 Arizona, California, Guam, Hawaii, Nevada	Davis Bernstein EPA - Region 9 215 Fremont St. San Francisco, CA 94105 Tel: (FTS) 556-4606 (415) 556-4606
Region 10 Alaska, Idaho, Oregon, Washington	Dave Hanline EPA - Region 10 1200 6th Ave. Seattle, WA 98101 Tel: (FTS) 399-1260 (206) 442-1260

Technical Assistance

cumulation of methane gas in a sewage tunnel. After obtaining technical assistance in the form of several peer matches, the County not only solved its problem, but won an award from the National Association of Counties for the development of an innovative land use planning tool.[4]

Auburn, Maine, had very little remaining capacity in its landfill and faced severe siting problems. With the aid of a TA Panels effort, the city has begun construction of a modular incineration system with waste heat recovery.[5] Both communities would be still facing great difficulties if technical assistance had not been available to them.

RCRA created a national policy that solid waste management should be undertaken in an environmentally sound manner. The Technical Assistance Panels Program has helped, and continues to help, state and local governments meet those goals. Among several other federal programs aimed at improving solid waste management practices, the TA Panels Program is unique in its flexibility, wide availability and timeliness of response. Without this program, many communities now implementing resource recovery would still be faced with severe solid waste disposal problems.

References

1. *Resource Conservation and Recovery Act of 1976*, PL 95-480, 90 Stat. 2795.
2. *Ibid.*, 90 Stat. 2804-05.
3. U.S. Environmental Protection Agency, *Technical Assistance and the Panels Program: Review of Fiscal Year 1978 Activity* (Washington, D.C.: U.S. Environmental Protection Agency, 1979), p. 3.
4. Jim Considine, Executive Director, Intergovernmental Methane Task Force, Adams County, Colo.; personal communication, July 1979.
5. Leo La Rochelle, Director of Public Works, City of Auburn, Maine; personal communication, July 1979.

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Systems, Facilities and Processes

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This section presents information on the careers that will soon be required to support our growing involvement with environmental problems and the new industries that are developing in response to those problems. The section is intended as a source of counseling information to further stimulate those students who have already expressed some interest in environmental matters as a possible career field.

In this era of "future shock," scientific advances and technological developments sometimes seem to be coming upon us a little too fast. Nevertheless, they are helping to meet new needs, and they bring new benefits. Today, the large-scale efforts of Americans to clean up their polluted environment and to deal more effectively with the collection, disposal, and recycling of solid wastes are leading to the creation of new systems, new approaches, new management, and new jobs. Earlier, the Space Age created a similar new round of jobs and opportunities. Odom Fanning, author of *Opportunities in Environmental Careers*, predicts that the number of those employed in environmental management will double in ten years, resulting in severe shortages of trained men and women to fill these jobs unless adequate provision for training is made.

What are the choices? What can young people do to help solve the environmental problems, especially those relating to solid waste management and resource recovery? Many students are asking these and other questions, such as what the educational requirements for various jobs are and where such courses are available.

The environment career spectrum is broad, with many possible types of occupations—working indoors or outdoors, doing research or making decisions, designing equipment or operating it. The range of careers covers many skills and levels of training. Some students may wish to enter a career that is directly concerned with conservation, with solid waste management, or with pollution control and resource recovery. But these are not the only fields in which important contributions can be made and in which the individuals may experience a sense of accomplishment, personal fulfillment, and gratification. To play an active role in meeting the environmental pollution challenge, students should begin planning now.

The following list points to key areas of study for preparation for environmental occupations:

Physics	Ecology	Hydrology
Chemistry	Meteorology	Bacteriolog
Geology	Limnology	Metallurgy
Biology		

Building architecture
Landscape architecture

Agronom
Statistics

Bacteriology
Epidemiology
Toxicology

Preventive medici
Public health

Sociology	Anthropology	Forestry
Law	Social work	Recreatic
Education	Urban planning	Writing
Economics	Soil conservation	Publicity

Chemical engineering
Civil engineering
Electrical engineering
Mechanical engineering
Metallurgy
Design engineering
Production engineerin
Engineering support services

In mee
ing the environmental challenge, scientists, engineers, lawyers, public health officers, public administrators, and members of many other professions will play an ever-widening role. These an similar careers require men and women with professional training, usually a master's or doctor's degree in one of these fields.

It is in this category that we find our scientists —the chemists, physicists, and many others. They are basically involved in research and development, working toward new technological breakthroughs. Their occupations often lead to high-ranking careers in research and management. Here also are engineers working on the manufa ture, fabrication, and end use of existing materials, and on the development of new materials, processes, and equipment.

Almost all these professionals require assistants whose jobs, though interesting, challenging and rewarding, require less academic training. This job category, called paraprofessional, includes laboratory and instrument technicians, repair and maintenance people, computer specia ists, and a wide range of skilled operators of complicated equipment. Some people in these jobs may have been educated in junior and community colleges or technical institutes, and others throug part-time day courses or evening study programs. Still others may enter the job market on the basis of informal apprenticeship and receive on-the-job training.

815 16th Street, N.W.
Washington, D.C. 20006
(National and Local Unions)

750 3rd Avenue
New York, N.Y. 10017
(Producers of Aluminum and Manufacturers of Semi-Fabricated Aluminum Products)

25711 Southfield Road
Southfield, Mich. 48075
(Industrial Hygienists)

150 East 42nd Street
New York, N.Y. 10017
(Basic Manufacturers in the Steel Industry)

P. O. Box 17407
Dulles International Airport
Washington, D.C. 20041
(Publishers of Daily Papers in the U.S., Canada, Bahamas, Bermuda, Puerto Rico and U.S. Virgin Islands)

260 Madison Avenue
New York, N.Y. 10016
(Manufacturers of Pulp, Paper and Paperboard)

821 15th Street, N.W.
Washington, D.C. 20005
(Manufacturers of Metal Cans, Containers and Packages made wholly or in part from Tin Plate or similar Sheet Metal)

1132 Pennsylvania Building
Washington, D.C. 20004
(Domestic Distillers of Beverage Alcohol for Whiskey, Vodka, Gin and Rum)

224 South Michigan Avenue
Chicago, Ill. 60604
(Manufacturers of Corrugated and Solid Fibre Shipping Containers)

226 South 16th Street
Philadelphia, Pa. 19102
(Glass Bottle Blowers Union)

1800 K Street, N.W.
Washington, D.C. 20036
(Glass Container and Closure Manufacturers, and Suppliers of Raw Materials and Equipment)

1333 Avenue of the Americas
New York, N.Y. 10036
(Manufacturers of Branded Food and Non-Food Products Sold Through Grocery Trade)

60 East 42nd Street
New York, N.Y. 10017
(Manufacturers of Incinerators for Municipal, Industrial, Commercial and Domestic Use)

1729 H Street, N.W.
Washington, D.C. 20006
(Scrap Iron and Steel Processors and Brokers)

1825 Connecticut Avenue, N.W.
Washington, D.C. 20009
(Manufacturers of Chemicals Who Sell a Substantial Portion of their Production to Others)

320 New Center Building
Detroit, Mich. 48202

1725 Eye Street, N.W.
Washington, D.C. 20006
(Retail Grocery Chains Operating 23,000 Individual Stores)

277 Park Avenue
New York, N.Y. 10017
(Representatives of American Manufacturing)

330 Madison Avenue
New York, N.Y. 10017
(Dealers, Processors and Generators of Waste Materials for Recycling)

360 North Michigan Avenue
Chicago, Ill. 60601
(Individual Food Retailers, Manufacturers and Distributors of Equipment, Food, Fixtures, Groceries and other Commodities used or sold by Food Stores)

1133 20th Street, N.W.
Washington, D.C. 20036
(Commercial Packers of Food Products in Hermetically Sealed Containers, Sterilized by Heat)

1101 16th Street, N.W.
Washington, D.C. 20036
(Manufacturers of Soft Drinks)

1145 19th Street, N.W.
Washington, D.C. 20036
(Commercial Solid Waste Collectors and Disposers)

342 Madison Avenue
New York, N.Y. 10017
(Users and Manufacturers of Packaging Materials, Machinery and Services)

1250 Connecticut Avenue, N.W.
Washington, D.C. 20036
(Manufacturers of Paperboard Packaging)

THE RESOURCE CONSERVATION AND RECOVERY ACT

- **The basic objectives of RCRA:**
  - Improved practices in solid waste disposal to protect public health and environmental quality.
  - Regulatory control of hazardous waste from generation through disposal.
  - Establishment of resource conservation as the preferred solid waste management approach.

- **RCRA provides the following means to achieve these objectives:**
  - Grants are authorized to State and local governments to develop their solid waste management programs. In fiscal year 1978, grants to States totalled $14.3 million.
  - A Technical Assistance Panels program is required to assist State and local governments with their solid waste problems by making available panels of personnel consisting of Federal, State, and local employees and consultants. Requests for such assistance are being handled by the Regional Offices.
  - Regulations and guidelines are being developed to set standards for hazardous waste management and for all land disposal facilities. Guidelines for State programs, for citizen participation, and for procurement of goods containing recycled materials are also required by the Act.
  - EPA has authority to operate and enforce the hazardous waste regulatory program in States that do not establish an authorized program.
  - Research, development, and demonstrations are authorized to expand knowledge and technology relating to land disposal, hazardous waste management, and resource conservation.
  - The interagency Resource Conservation Committee is mandated to study and report on policies and proposals affecting resource conservation.
  - Public participation is required in the development of all regulations, guidelines, and programs under the Act; public education and information programs are also required to promote public understanding of the issues and enable constructive participation. Over 100 public meetings have been held to solicit public comment on RCRA issues, and educational programs are being sponsored around the country.

- **EPA strategy in implementing the law over the next 5 years will emphasize:**
  - **Controlling waste disposal** through hazardous waste regulation, land disposal provisions, and development of State programs.
  - **Encouraging resource conservation** through development of economic incentives, State and regional programs, and research, development, demonstrations, and evaluations.

- **Focusing priority attention on disposal of industrial wastes**, because of their relatively greater toxicity and greater quantity; programs related to municipal wastes will be able to proceed more rapidly, however, due to already existing knowledge and institutional framework.
- **Maximizing State assumption** of RCRA authorities through Federal assistance, regulations, guidelines, and public support.

- **Appropriations for EPA activities under RCRA (in millions)**

Office	1977	1978	1979*
Office of Solid Waste	$ 8.2	$14.7	$ 11.6
Regional Offices	1.8	2.2	7.1
Office of Research and Development	4.2	7.6	10.9
Office of Enforcement	0.1	1.0	1.1
Grants to States	2.9	14.3	26.2
Grants for resource recovery	–	–	15
Total	$17.3	$39.8	$71.9

*Requested in the President's Budget

- **State programs and RCRA**
  - State government budgets for solid waste management totalled an estimated $28 million in 1977. (EPA solid waste grants that year totalled $3 million.)
  - There are now about 1,000 employees in State solid waste management programs, compared with fewer than 10 in 1965.
  - All States have some authority over disposal of municipal solid waste and should be able to move aggressively into the regulation of such disposal to meet RCRA requirements.
  - Many States have enacted legislation for regulation of hazardous waste in recent years. We expect 30-35 States to qualify for "interim authorization" to regulate hazardous waste in lieu of EPA.
  - Few States currently have authority over the disposal of sludges or industrial solid waste.
  - Few States have a resource conservation and recovery program; we would expect all States to have some form of a program in FY-1980.

fact sheet -13.0

NATIONAL CENTER FOR RESOURCE RECOVERY, INC.

1211 CONNECTICUT AVE., N.W., WASHINGTON, D.C. 20036 (202/223-6154)

RESOURCE Briefs RECOVERY

September 1[illegible]

RESOURCE RECOVERY INFORMATION SOURCES AND PUBLICATIONS

In the rapidly advancing field of resource recovery from municipal solid waste, the requirement for accurate and current information is paramount. To whom can a city, agency or independent contractor turn for assistance, whether it be information about systems status, source separation (i.e. curbside and "recycling" centers), markets, specifications, research projects and reports, etc.?

To help fill this need, the National Center for Resource Recovery has assembled the following listing of agencies, organizations and publications that provide various types of information about resource recovery.

U.S. Government Agencies

DEPARTMENT OF COMMERCE
Office of Environmental Affairs
Commerce Building
14th St. & Constitution Ave., N.W.
Washington, D.C. 20230 (202/377-4335)

National Technical Information Service
5285 Port Royal Rd.
Springfield, Va. 22161 (703/557-4600)

DEPARTMENT OF ENERGY
Urban Waste Technology Branch
Washington, D.C. 20545 (202/376-1964)

DEPARTMENT OF THE INTERIOR
Bureau of Mines
Avondale Research Center
4900 La Salle Rd.
Avondale, Md. 20782 (301/436-7510)

ENVIRONMENTAL PROTECTION AGENCY
Office of Solid Waste
401 M St., S.W.
Washington, D.C. 20460 (202/755-9170)

Solid Waste Publication Distribution
26 West St. Clair St.
Cincinnati, Ohio 45268 (513/684-8491)

Industrial Environmental Research Laboratory
Cincinnati, Ohio 45268 (513/684-4402)

Municipal Environmental Research Laboratory
Cincinnati, Ohio 45268 (513/684-7951)

Organizations

THE ALUMINUM ASSOCIATION
818 Connecticut Ave., N.W.
Washington, D.C. 20006 (202/862-5100)

AMERICAN CHEMICAL SOCIETY
1155 16th St., N.W.
Washington, D.C. 20036 (202/872-4600)

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS
345 East 47th St.
New York, N.Y. 10017 (212/452-7100)

AMERICAN IRON AND STEEL INSTITUTE
1000 16th St., N.W.
Washington, D.C. 20036 (202/452-7100)

AMERICAN PAPER INSTITUTE
260 Madison Ave.
New York, N.Y. 10016 (212/340-0600)

AMERICAN PUBLIC WORKS ASSOCIATION
Institute for Solid Waste
1776 Massachusetts Ave., N.W.
Washington, D.C. 20036 (202/833-1188)

AMERICAN SOCIETY FOR TESTING AND MATERIALS
Committee E-38 on Resource Recovery
1916 Race St.
Philadelphia, Pa. 19103 (215/299-5400)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS
Solid Waste Processing Division
345 East 47th St.
New York, N.Y. 10017 (212/644-7555)

CHAMBER OF COMMERCE OF THE U.S.
1615 H St., N.W.
Washington, D.C. 20062 (202/659-6000)

ELECTRIC POWER RESEARCH INSTITUTE
1750 New York Ave., N.W.
Washington, D.C. 20006 (202/872-9222)

GLASS PACKAGING INSTITUTE
1800 K St., N.W.
Washington, D.C. 20006 (202/872-1280)

GOVERNMENTAL REFUSE COLLECTION AND DISPOSAL ASSOCIATION
1629 K St., N.W.
Washington, D.C. 20006 (202/223-6627)

INSTITUTE OF SCRAP IRON AND STEEL
1627 K St., N.W.
Washington, D.C. 20006 (202/466-4050)

INTERNATIONAL CITY MANAGEMENT ASSOCIATION
1140 Connecticut Ave., N.W.
Washington, D.C. 20036 (202/293-2200)

NATIONAL ASSOCIATION OF COUNTIES
1735 New York Ave., N.W.
Washington, D.C. 20006 (202/785-9577)

NATIONAL ASSOCIATION OF RECYCLING INDUSTRIES
330 Madison Ave.
New York, N.Y. 10017 (212/867-7330)

NATIONAL ASSOCIATION OF REGIONAL COUNCILS
1700 K St., N.W.
Washington, D.C. 20006 (202/457-0710)

NATIONAL CENTER FOR RESOURCE RECOVERY, INC.
1211 Connecticut Ave., N.W.
Washington, D.C. 20036 (202/223-6154)

NATIONAL CONFERENCE OF STATE LEGISLATURES
444 North Capitol St.
Washington, D.C. 20001 (202/624-5420)

NATIONAL GOVERNORS ASSOCIATION
444 North Capitol St.
Washington, D.C. 20001 (202/624-5375)

NATIONAL LEAGUE OF CITIES/U.S. CONFERENCE OF MAYORS
1620 Eye St., N.W.
Washington, D.C. 20006 (202/293-7300)

NATIONAL SOLID WASTES MANAGEMENT ASSOCIATION
Waste Equipment Manufacturers Institute
1120 Connecticut Ave., N.W.
Washington, D.C. 20036 (202/659-4613)

SMITHSONIAN SCIENCE INFORMATION EXCHANGE, INC.
1730 M St., N.W., Room 300
Washington, D.C. 20036 (202/381-4211)

SOCIETY OF THE PLASTICS INDUSTRY, INC.
355 Lexington Ave.
New York, N.Y. 10017 (212/573-9400)

Publications

AMERICAN CITY AND COUNTY
Morgan-Grampian Publishing Co.
Berkshire Common
Pittsfield, Mass. 01201 (413/499-2550)

COMPOST SCIENCE
JG Press, Inc.
Box 351
Emmaus, Pa. 18049 (215/967-4010)

CONSERVATION AND RECYCLING
Pergamon Press Ltd.
Maxwell House, Fairview Park
Elmsford, N.Y. 10523 (914/592-7700)

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1301 South Grove
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"BOTTLE BILL" AS ENACTED BY OREGON LEGISLATIVE ASSEMBLY—1971 REGULAR SESSION AND AMENDED BY OREGON LEGISLATIVE ASSEMBLY—1973 REGULAR SESSION

Relating to beverage containers; and providing penalties.

BE IT ENACTED BY THE PEOPLE OF THE STATE OF OREGON:

SECTION 1. As used in this Act, unless the context requires otherwise:

(1) "Beverage" means beer or other malt beverages and mineral waters, soda water and similar carbonated soft drinks in liquid form and intended for human consumption.

(2) "Beverage container" means the individual, separate sealed glass, metal or plastic bottle, can, jar or carton containing a beverage.

(3) "Commission" means the Oregon Liquor Control Commission.

(4) "Consumer" means every person who purchases a beverage in a beverage container for use or consumption.

(5) "Dealer" means every person in this state who engages in the sale of beverages in beverage containers to a consumer, or means a redemption center certified under section 8 of this Act.

(6) "Distributor" means every person who engages in the sale of beverages in beverage containers to a dealer in this state including any manufacturer who engages in such sales.

(7) "In this state" means within the exterior limits of the State of Oregon and includes all territory within these limits owned by or ceded to the United States of America.

(8) "Manufacturer" means every person bottling, canning or otherwise filling beverage containers for sale to distributors or dealers.

(9) "Place of business of a dealer" means the location at which a dealer sells or offers for sale beverages in beverage containers to consumers.

(10) "Use or consumption" includes the exercise of any right or power over a beverage incident to the ownership thereof, other than the sale or the keeping or retention of a beverage for the purposes of sale.

SECTION 2. (1) Except as provided in subsection (2) of this section, every beverage container sold or offered for sale in this state shall have a refund value of not less than five cents.

(2) Every beverage container certified as provided in section 6 of this Act, sold or offered for sale in this state shall have a refund value of not less than two cents.

SECTION 3. Except as provided in Section 4 of this Act:

(1) A dealer shall not refuse to accept from any person any empty beverage containers of the kind, size and brand sold by the dealer, or refuse to pay to that person the refund value of a beverage container as established by section 2 of this Act.

(2) A distributor shall not refuse to accept from a dealer any empty beverage containers of the kind, size and brand sold by the distributor, or refuse to pay the dealer the refund value of a beverage container as established by section 2 of this Act.

SECTION 4. (1) A dealer may refuse to accept from any person, and a distributor may refuse to accept from a dealer any empty beverage container which does not state thereon a refund value as established by section 2 of this Act.

(2) A dealer may refuse to accept and to pay the refund value of empty beverage containers if the place of business of the dealer and the kind and brand of empty beverage containers are included in an order of the commission approving a redemption center under section 8 of this Act.

SECTION 5. (1) Every beverage container sold or offered for sale in this state by a dealer shall clearly indicate by embossing or by a stamp, or by a label or other method securely affixed to the beverage container, the refund value of the container.

(2) Subsection (1) of this section shall not apply to glass beverage containers designed for beverages having a brand name permanently marked thereon which, on the operative date of this Act had a refund value of not less than five cents.

(3) No person shall sell or offer for sale at retail in this state any metal beverage container so designed and constructed that a part of the container is detachable in opening the container without the aid of a can opener.

SECTION 6. (1) To promote the use in this state of reusable beverage containers of uniform design, and to facilitate the return of containers to manufacturers for reuse as a beverage container, the commission may certify beverage containers which satisfy the requirements of this section.

(2) A beverage container may be certified if:

(a) It is reusable as a beverage container by more than one manufacturer in the ordinary course of business; and

(b) More than one manufacturer will in the ordinary course of business accept the beverage container for reuse as a beverage container and pay the refund value of the container.

(3) The commission may by rule establish appropriate liquid capacities and shapes for beverage containers to be certified or decertified in accordance with the purposes set forth in subsection (1) of this section.

(4) A beverage container shall not be certified under this section if by reason of its shape or design, or by reason of words or symbols permanently inscribed thereon, whether by engraving, embossing, painting or other permanent method, it is reusable as a beverage container in the ordinary course of business only by a manufacturer of a beverage sold under a specific brand name.

SECTION 7. (1) Unless an application for certification under section 6 of this Act is denied by the commission within 60 days after the filing of the application, the beverage container shall be deemed certified.

(2) The commission may review at any time certification of a beverage container. If after such review, with written notice and hearing afforded to the person who filed the application for certification under section 6 of this Act, the commission determines the container is no longer qualified for certification, it shall withdraw certification.

(3) Withdrawal of certification shall be effective not less than 30 days after written notice to the person who filed the application for certification under section 6 of this Act, and to the manufacturers referred to in subsection (2) of section 6 of this Act.

SECTION 8. (1) To facilitate the return of empty beverage containers and to serve dealers of beverages, any person may establish a redemption center, subject to the approval of the Oregon Liquor Control Commission, at which any person may return empty beverage containers and receive payment of the refund value of such beverage containers.

(2) Application for approval of a redemption center shall be filed with the commission. The application shall state the name and address of the person responsible for the establishment and operation of the redemption center, the kind and brand names of the beverage containers which will be accepted at the redemption center and the names and addresses of the dealers to be served by the redemption center. The application shall include such additional information as the commission may require.

(3) The commission shall approve a redemption center if it finds the redemption center will provide a convenient service to persons for the return of empty beverage containers. The order of the commission approving a redemption center shall state the dealers to be served by the redemption center and the kind and brand names of empty beverage containers which the redemption center must accept. The order may contain such other provisions to insure the redemption center will provide convenient service to the public as the commission may determine.

(4) The commission may review at any time approval of a redemption center. After written notice to the person responsible for the establishment and operation of the redemption center, and to the dealers served by the redemption center, the commission may, after hearing, withdraw approval of a redemption center if the commission finds there has not been compliance with its order approving the redemption center, or if the redemption center no longer provides a convenient service to the public.

SECTION 9. The procedures for certification or withdrawal provided for in sections 6 to 8 of this Act shall be in accordance with ORS chapter 183.

SECTION 10. (1) Any person who violates section 2, 3 or 5 of this Act shall be punished, upon conviction, as for a misdemeanor.

(2) In addition to the penalty prescribed by subsection (1) of this section, the commission or the State Department of Agriculture may revoke or suspend the license of any person who wilfully violates section 2, 3 or 5 of this Act, who is required by ORS chapter 471 or 635, respectively, to have a license.

SECTION 11. (1) During the period commencing October 1, 1972, and ending when it submits the report provided for in subsection (2) of this section, the Legislative Fiscal Committee shall cause to be conducted a study of the operation of sections 1 to 10 of this Act that shall include, but not be limited to, an analysis of:

(a) Its economic impact on persons licensed under ORS chapter 635 who engage in the nonalcoholic beverage manufacturing business, on persons engaged in the business of manufacturing beer and other malt beverages and on persons engaged in the business of manufacturing beverage containers in complying with provisions of sections 1 to 10 of this Act.

(b) The problems, if any, incurred in the distribution, sale and return of beverage containers subject to the provisions of sections 1 to 10 of this Act.

(c) The effectiveness of the provisions of sections 1 to 10 of this Act in the reduction of the incidence of the littering by beverage containers in this state.

(d) The costs incurred in the enforcement of the provisions of sections 1 to 10 of this Act.

(2) Prior to January 1, 1975, the Legislative Fiscal Committee shall prepare and submit to the Fifth-eighth Legislative Assembly of the State of Oregon a report of its findings made pursuant to subsection (1) of this section and its recommendations with respect to any legislative proposals considered by it to be necessary as the result of the study conducted as required by subsection (1) of this section.

SECTION 12. This Act shall not become operative until October 1, 1972, and shall apply to all beverage containers sold or offered for sale after October 1, 1972, except that applications under sections 6 and 8 of this Act may be made prior to October 1, 1972, the certification referred to in section 6 of this Act and the approval referred to under section 8 of this Act may be delivered prior to October 1, 1972, and the commission shall adopt rules and regulations under sections 6 and 8 of this Act prior to October 1, 1972.

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TIDEWATERS — DEPOSIT OF MATERIALS IN REGULATED
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UNDERGROUND WATERS — DEFINITION
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387.01

UNDERGROUND WATERS — DRAINAGE INTO REGULATED
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387.05

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GLOSSARY

SOLID WASTE DEFINITIONS

ABANDONED VEHICLES
Passenger automobiles, buses, trucks, motorcycles, farm implements, and trailers that are no longer useful as such and have been left elsewhere than a recognized junk yard or auto destructor.

AEROBIC
Able to live and grow only if free oxygen is present.

AEROSOL
Fine solid or liquid particles suspended in a gas.

AGGREGATE
Crushed rock or gravel used in road surfaces and concrete.

AGRICULTURAL WASTE
Waste materials left over from raising plants and animals for food. These materials include such things as animal manure, plant stalks, hulls, and leaves.

AIR CLASSIFIER
A mechanical device that uses a force of air to separate mixed trash and rubbish according to weight.

AIR DEFICIENCY
The condition in which there is not enough air in an air-fuel mixture to supply the quantity of oxygen needed to oxidize the fuel.

AIR POLLUTANT
A substance discharged into the atmosphere in large enough concentrations to contaminate the environment.

AIR POLLUTION
The condition in which the atmosphere has an overconcentration of harmful substances.

AIR POLLUTION CONTROL DEVICE
Equipment for removing fly ash, particulates, and some gaseous or chemical products of combustion from the stack effluent prior to release to the atmosphere. Such equipment may be electrostatic precipitators or high efficiency wet scrubbers.

AIR QUALITY STANDARDS
Legal restrictions on the quantity of a particular air-polluting substance that can be present in the air at any one time.

ALUMINUM
A strong, light, silver-colored metal derived chiefly from bauxite. It is the most abundant metal in the earth's crust.

AMBIENT AIR
The surrounding air.

ANAEROBIC
Able to live and grow in the absence of real oxygen.

ASHES
Residue from the burning of wood, coal, coke, or other combustible materials.

AUXILIARY FUEL FIRING EQUIPMENT
Equipment to supply additional heat, by the combustion of an auxiliary fuel, for the purpose of attaining temperatures sufficiently high (a) to dry and ignite the waste material, (b) to maintain ignition thereof, and (c) to promote complete combustion of combustible solids, vapors and grease.

BACKEND LOADER
A refuse truck that loads refuse and trash from the rear of the truck and compacts it.

"BACK-END" SYSTEM
Any of several processes for recovering value, such as energy, from the organic portion of the waste stream. Examples of such processes are fluid bed incineration, pyrolysis, composting, combustion, and fiber reclaiming.

BACTERIA
Single-celled, microscopic organisms that can cause disease but that are also important to man because of their chemical effect of such things as solid waste.

BAFFLE
Any refractory construction intended to change the direction of flow on the products of combustion.

BAGASSE
An agricultural waste material consisting of the dry pulp residue remaining from the processing of sugarcane after the juice has been extracted. The fibers are used as raw materials in the manufacture of pulp and paper.

BALING
A volume-reducing system in which waste material is mechanically compressed and bound into large cubelike shapes.

BIOCHEMICAL OXYGEN DEMAND (BOD)
A measure of the amount of oxygen used by micro-organisms to break down organic waste materials in water.

BIODEGRADABLE
Capable of having its physical and/or chemical structure broken down by microorganisms. Most organic waste, such as food remains and paper, is biodegradable.

BIOSPHERE
The part of the earth's crust, water, and atmosphere where living organisms can subsist.

BOXBOARD
Paperboard used in the manufacture of cartons and rigid boxes. (See PAPERBOARD).

BREECHING (FLUE CONNECTION)
A passage for conducting the products of combustion to the stack or chimney.

BTU (BRITISH THERMAL UNIT)
The quantity of heat required to increase the temperature of one pound of water from 60 degrees to 61 degrees F. In resource recovery systems, BTU would be applied to indicate the amount of heat energy available if a given amount of waste was burned.

BROKE
Paper that has been discarded anywhere in the process of manufacture. It is usually returned to a repulping unit for reprocessing.

BULKY WASTE
Large items of refuse such as appliances, furniture, large auto parts, trees and branches, large containers, rubber tires, etc.

BURNER
A device for either municipal or on-site volume reduction of refuse by burning, and of simple construction. Not to be confused with an incinerator, which, properly designed and operated, can produce an acceptable emission and residue.

BURNING AREA (INCINERATOR)
The horizontal projected area of grate, hearth, or the combination where burning takes place.

BURNING RATE
The amount of waste consumed, usually expressed in pounds per hour per square foot of burning area. Occasionally expressed as BUT per hour per square foot of burning area, which refers to the heat liberated by combustion of the waste.

BYPASS
An arrangement of breechings or flue connections and dampers to permit the alternate use of two or more pieces of equipment by directing or diverting the flow of the products of combustion.

CAPACITY RATED
The theoretical amount of solid, semi-solid, gaseous or liquid wastes that can be burned to an inoffensive residue containing little or no combustible material,and/or gaseous by-product in a given time period usually expressed in pounds per hour or tons per day.

CARBONACEOUS MATTER
Carbon compounds or pure carbons that are present in the fuel residue of the combustion process.

CARBON DIOXIDE (CO_2)
A colorless, odorless, nonpoisonous gas that forms carbonic acid when dissolved in water. It is produced during the thermal degradation and microbial decomposition of solid wastes.

CARBON MONOXIDE
A colorless, poisonous gas that has a very faint metallic odor and taste. It is produced during the thermal degradation and microbial decomposition of solid wastes when the oxygen supply is limited.

CELL
A section of solid waste that is compacted and covered over by natural soil or a cover material in a sanitary landfill.

CENTRAL GARBAGE GRINDER
A site where all the food waste in a particular area is brought to be pulverized.

CHUTE, CHARGING (INCINERATOR)
A pipe or duct through which wastes are conveyed from above to the primary chamber.

CLASSIFICATION
The arrangement and sorting of waste materials into categories or classes. This usually means grading by organic or inorganic composition, size, weight, color, shape, etc., in specialized equipment.

COLLECTION
The act of picking up waste materials at residences, businesses, or industrial sites and hauling it to a facility for processing.

COLLECTION CENTER
A place where individuals can take particular waste materials, such as glass or cans, or a place where government or private agencies can take wastes that they have collected.

COLLECTION VEHICLES
Vehicles used to pick up trash and haul it to a collection center or transfer station (See BACKEND LOADER, COMPACTOR TRUCK, FRONTEND LOADER, SIDE LOADER.)

COLOR SORTING OF GLASS
A technique for sorting by color the glass reclaimed from solid waste. The sorting might be optical (whcih compares light reflected from each piece with light reflected from a background standard) or magnetic (which sorts colored glass containing iron from clear glass with no iron).

COMBUSTIBLES
Burnable waste materials, usually such organic materials as paper, plastics, wood and food wastes.

COMBUSTION
The chemical combining of oxygen with a substance resulting in the production of heat and usually light.

COMBUSTION AIR (EXCESS)
Air supplied in excess of theoretical air, usually expressed as a percentage of the theoretical air. Also called excess air.

COMBUSTION AIR (THEORETICAL)
Air, calculated from the chemical composition of waste, required to burn the waste completely without additional air. Also designated as stoichiometric air.

COMBUSTION CHAMBER
Chamber where ignition and burning of the waste occur.

CRUSHER
A mechanical device used to break up waste material into smaller sizes by a pounding action using hammers, beaters, etc. (See HAMMER MILL.)

CULLET
Scrap glass, usually broken up into small uniform pieces. It is often reused in the manufacture of new glass.

CYCLONE SEPARATOR
A mechanical separator that uses swirling air to sort materials according to weight (See SEPARATION.)

DEAD ANIMALS
Those that die naturally, from disease or are accidently killed. Condemned animals or parts of animals from slaughter houses or similar places are not included in this term, but are regarded as industrial refuse.

DECOMPOSITION
The breakdown of organic waste materials by microorganisms. Total decomposition leaves only carbon dioxide, water, and inorganic solids. Decomposition occurs naturally in the open, as in dumps and landfills, or it can be harnessed in waste treatment equipment to work under controlled conditions. (See BIODEGRADABLE and COMPOSTING.)

DEINKING
A process in which most of the ink, filler, and other extraneous material is removed from printed and/or unprinted reclaimed paper. The result is a pulp that can be used, along with varying percentages of virgin paper, in the manufacture of new paper, including high-quality printing, writing, and office paper, as well as tissue and toweling.

DEMOLITION WASTE
Waste materials produced from the destruction of buildings, roads, sidewalks, etc. (See CONSTRUCTION WASTE, RUBBLE, SOLID WASTE, and WASTE MATERIALS.)

DEWATERING
The process of removing water from waste by filtration, centrifugation, pressing, open-air drying, and other methods. Dewatering makes sewage sludge suitable for disposal by burning or by landfill. The term is also used when removing water from pulp.

DIGESTER
A mechanical device that softens or decomposes waste material, usually for further processing.

DISINFECTION
Killing of pathogenic agents outside the body by chemical or physical means directly applied.

DISPOSABLE STORAGE CONTAINERS
Plastic or paper sacks used for temporary storage of solid waste.

DISPOSAL
The final disposition of wastes, usually through burning or burying.

DISPOSAL AREA
A site, location, tract of land, area, building, structure or premises used or intended to be used for partial and/or total refuse disposal.

DISTILLATION
A separation process used to remove water from waste material in some treatment or recovery systems. The water is vaporized, removed from the unit, and condensed back into a liquid.

DOMESTIC REFUSE
All those types of solid waste which mornally originate in the residential household or apartment house.

DRAFT
The pressure difference between the incinerator, or any component part, and the atmosphere, which causes the products of combustion to flow from the incinerator to the atmosphere.

Natural - The negative pressure created by the difference in density between the hot flue gases and the atmosphere.
Induced - The negative pressure created by the action of a fan, blower or ejector located between the incinerator and the stack.
Forced - The positive pressure created by the action of a fan or blower, supplying the primary or secondary air.

DRYING HEARTH
A surface within the primary chamber upon which wet waste material is deposited for drying prior to burning.

DUMP
A open land site where waste materials are burned, left to decompose or rust, or simply deposited. In most localities, dumps are being phased out because of the problems they cause, such as water pollution, creation of unsanitary conditions, and general unsightliness. Dumps are also breeding grounds for rodents and other disease carriers.

ECOLOGY
The scientific study of the relations of living things to one another and to their environment. A scientist who studies these relationships is called an ecologist.

ECOSYSTEM
All living things and their environment in an area of any size. All are linked together by energy and nutrient flow.

EDAPHIC
Related to or caused by particular soil conditions, as of texture or drainage, rather than by physiographic or climatic factors.

EFFLUENT
Solid, liquid, or gas waste that enters the environment as a by-product of extractive or manufacturing processes.

ELECTROSTATIC PRECIPITATOR
A device that collects unwanted particles from a solution by using an electric charge to attract them onto a collecting electrode. This process is sometimes used in incinerators, furnaces, and treatment plants to collect or separate dust particles.

EMISSION
The gases, vapor, and particulates that reach the atmosphere from the burning process.

ENERGY RECOVERY
A type of resource recovery in whic all or part of the waste materials going into a recovery facility are burned to produce heat that can be used to produce steam for heating or for the generation of electricity. (See CONVERSION.)

ENVIRONMENT
The aggregate of surrounding things, conditions, or influences, especially as affecting the existence or development of people or of nature.

ENVIRONMENTAL PROTECTION AGENCY (EPA)
An agency of the federal government formed in 1970 to have the responsibility for ensuring that governmental, residential, commercial, and industrial waste disposal activities do not adversely affect the physical environment.

ENVIRONMENTAL SYSTEM
The interaction of an organism or a group of organisms with its natural and man-made surroundings.

ENVIRONMENTAL RESISTANCE
The limiting effect of environment conditions on the numerical growth of a population.

EUTROPHICATION
Enrichment of soils and water due to fertilization, sewage effluent, or other waters that carry a high plant-nutrient component.

EXCESS AIR
The air remaining after a fuel has been completely burned, or that air supplied in addition to the theoretical quantity.

FERROUS
Pertaining to metals that are predominantly composed of iron. In the waste materials stream, these usually include steel or tin cans, automobiles, old refrigerators, stoves, etc.

FIBER
Any long, narrow cell of wood or bast, Loosely used for wood elements in general.

FILTER
A device through which a liquid or gas is passed in order to remove particles of dust.

FLUE GAS WASHER OR SCRUBBER
Equipment for removing fly ash and other objectionable materials from the products of combustion by means of sprays, wet baffles, etc. Also reduces the temperature of effluent gases.

FLUID BED INCINERATOR
An incinerator in which the waste material is fluidized by an upward-controlled air flow. A bed of solids acts like a fluid when an upward flow of air has just enough velocity to float some of the solids. One such incinerator confines combustion within a bed of waste and sand supported on a perforated plate. Air is blown upward through the plate, churning the waste and sand into a turbulent mass like quicksand. Volatile gases are collected above the bed.

FLY ASH
Small solid particles of ash and soot produced when burning coal, oil, or waste materials. After these particles are collected, they can be used for making building materials such as brick or deposited in a sanitary landfill.

FLY ASH COLLECTOR
Equipment for trapping and removing fly ash from the products of combustion.

FOOD CHAIN
A series or chain of plants and animals that depend on each other for a food supply. An example is algae-shrimp-fish-man.

FOSSIL FUELS
Fuels such as coal, oil, and natural gas that are the remains of ancient plant and animal life.

FRONTEND LOADER
A truck with mechanical arms at the front that lift a refuse container up and over the cab to theback of the truck, where the contents of the container are dumped and compressed.

"FRONT-END" SYSTEM
Any of several processes that separate and recover valuable resources from inorganic solid waste. Examples are shredding, grinding, screening, flotation, and magnetic and air separation.

FURNACE
The area in an incinerator where the preheating, drying, ignition, and most of the burning of refuse takes place.

GARBAGE
Rejected food wastes including waste accumulation of animal, fruit or vegetable matter used or intended for food or that attend the preparation, use, cooking, dealing in or storing of meat, fish, fowl, fruit or vegetable, that are likely to decompose or putrefy.

GARBAGE GRINDING
A method of uniformly reducing food waste or garbage and placing the reduced product in sewer systems. The reducing device may be a home sink grinder, or a large central grinder which serves industry or the community. It is noted that the ground garbage, which should pass through a sewage treatment plant, must still be disposed of as sewage sludge after treatment.

GASES, INCINERATOR
Combustion gases which may contain water vapor and excess or dilution air added after the combustion chamber.

GASIFICATION
The process of converting a solid or liquid fuel into a gaseous fuel.

GENERATION
The act or process of producing solid waste.

GLASPHALT
A highway paving material in which recovered ground glass replaces gravel in asphalt.

GLASS
A transparent inorganic material that is produced by melting almost pure silica sand with burnt lime or limestone, with soda ash added to give hardness and chemical durability. Crushed glass, or cullet, has traditionally been added to make the mixture of raw materials more workable.

GRATE
Surface with suitable openings, to support the refuse and permit passage of air through the burning fuel. It is usually located in the primary combustion chamber, and is designed to permit movement of unburned refuse or residue, and may be horizontal or inclined and stationary or movable.

GRAVITY SEPARATION (FLOTATION, HEAVY MEDIA)
Separation of materials according to specific gravity by immersion in liquid. In solid waste recovery this process enables separation of the various nonferrous metals from other heavy metals.

GRINDER
A mechanical device that pulverizes waste material into powder or small particles by rubbing them between two hard surfaces.

GRINDING
The mechanical pulverization of solid waste. (See SHREDDER.)

GROUNDWATER
Water that is present in the zone of saturation of a bed of rock, sand, or gravel. The upper surface of the groundwater forms the water table.

HABITAT
The natural environment of an animal or a plant.

HAMMER MILL
A mechanical device composed of heavy rotating hammers that crush waste material into smaller size pieces.

HAZARDOUS WASTES
Includes, but is not limited to, explosives, pathological wastes, radioactive materials and chemicals.

HEAT EXCHANGER
A device for transferring heat from one medium to another by conduction through a third material. In a boiler, the processes whereby hot gases pass over water-filled metal tubes, to cool the gases and to convert the water to steam.

HEAT OF COMBUSTION
The amount of heat, usually expressed as BTU per pound of as-fired or dry waste, liberated by combustion at a reference temperature of 68 degrees F. With reference to auxiliary gas, it is expressed as BTU per standard cubic foot, and to auxiliary oil as BTU per pound or gallon. Also called heating value.

HEAT RELEASE RATE
The amount of heat liverated in the primary combustion chamber, usually expressed as BTU per hour per cubic foot.

HETEROGENEOUS WASTE
Waste that contains a mixture of materials, such as metals, glass, paper, plastics and food.

HOMOGENEOUS WASTE
Unmixed waste material composed of similar materials, such as various kinds of paper waste.

HULK
The body part of a vehicle that remains after such valuable parts as motor, transmission and axles have been removed.

HYDRAPULPER
A large mechanical device used in the paper industry to pulp waste paper and separate foreign matter.

HYDROCARBONS
Any compounds containing only hydrogen and carbon. Hydrocarbon air pollutants come mostly from incompletely burned fuel.

INCINERATION
The controlled process by which solid, liquid, or gaseous combustible wastes are burned and changed into gases, with the residue produced containing little or no combustible material. (See COMBUSTION, FLUID BED INCINERATOR, FURNACE, GRATE, INCINERATOR, PRYOLYSIS, SCRUBBER, and WATER-WALL FURNACE.)

INCINERATOR
A plant designed to reduce waste volume by combustion. Incinerators consist of refuse-handling and storage facilities, furnaces, combustion chambers, subsidence chambers, residue-handling and removal facilities, and chimneys. Complete conventional incineration reduces waste volume by about 90 percent, whereas high-temperature incineration achieves as much as 98 percent reduction.

INDUSTRIAL REFUSE
All solid wastes which result from industrial processes and manufacturing operations such as factories, processing plants, repair and cleaning establishments, refineries and rendering plants.

INORGANIC REFUSE
Waste material coming from matter other than plants, animals, certain chemical compounds, or carbon. Examples are metals and glass. (See ORGANIC REFUSE.)

IN-PLANT WASTE
Waste material discarded during the manufacturing process. It can be and usually is recovered and recycled within the plant.

INSTITUTIONAL WASTE
Waste material coming from schools, hospitals, public buildings, etc.

JUNK
Waste materials - such as rags, paper, metal, toys and furniture - that are usually suitable for recycling and reuse, and are sorted but unprocessed.

KRAFT PAPER
A comparatively coarse paper made primarily from wood pulp produced by the sulfate pulping process and particularly noted for its strength. Its unbleached grades are used mainly as a wrapping or packaging material.

LANDFILL
A method of disposing of refuse on land by utilizing the principles of engineering to confine the refuse to the smallest practical area and to reduce it to the smallest practical volume.

LEACHING
The removal of soluble substances from soil by percolating water.

LEACHATE
Liquid that drains out of landfills and that contains decomposed waste, bacteria, and other contaminants. It must be collected and treated so as not to contaminate water supplies.

LIFE CYCLE
The continuous sequence of changes undergone by an organism from one primary form to the development of the same form again.

LIGNIN
The organic substance that holds together the individual fibers of wood. Lignin is responsible for the dark color in pulp mill effluents.

LITTER
Solid waste that has been carelessly discarded by the consumer and that is outside the system for collecting and disposing of trash and garbage.

MAGNETIC SEPARATOR
A mechanical device that uses a magnet to sort ferrous material from general waste material. (See SEPARATION.)

MANUAL SEPARATION
The separation of waste materials by hand.

MATERIALS RECOVERY
One of the concepts of resource recovery in which the emphasis is on separating and processing waste materials to be sold for various purposes.

MECHANICAL SEPARATOR
Any separator of waste materials that is mechanical in design, such as a cyclone or screen separator. (See SCREENING and SEPARATION.)

METALS
All ferrous, nonferrous, and alloy materials.

METHANE (CH_4)
An odorless, colorless, and asphyxiating gas produced by solid waste undergoing anaerobic decomposition. Under certain circumstances this gas is highly explosive.

MICROORGANISM
Any living thing of microscopic size, such as bacteria, yeasts, simple fungi, some algae, slime molds, and protozoans. Microorganisms are involved in the composting of waste materials and in sewage treatment processes.

MIXED PAPER
Wastepaper of various kinds and levels of quality, usually collected from stores, offices, and schools.

MUNICIPAL COLLECTION
An arrangement whereby the city pays the collection personnel and operation is by city departments.

MUNICIPAL SOLID WASTE
Waste materials produced in a municipal area containing both residences and businesses.

NEWSPRINT
The kind of paper generally used for printing newspapers.

NONCOMBUSTIBLE RUBBISH
Miscellaneous refuse materials that are unburnable at ordinary incinerator temperatures (1300 degrees F to 2000 degrees F).

NONFERROUS
Pertaining to metals that contain no iron. In solid waste these are usually aluminum, copper wire, brass, and bronze.

OCEAN DUMPING
The dumping of raw or treated wastes in the sea beyond the continental shelf. Ocean disposal, if not completely eliminated, should be carefully controlled so as to limit the kind, amount, and areas over which the wastes are dumped. Such control is needed to guarantee that the ecological balance of the sea is not disturbed.

OFFAL
Intestines and discarded parts of slaughtered animals.

ON-SITE DISPOSAL
Includes all means of disposal or volume reduction of refuse on premises before collection. Examples are garbage grinding; burning or incineration; burial; compaction; or slurrying at homes and commercial establishments.

OPEN BURNING
The burning of solid waste in the open, in outdoor incinerators, or in a dump. Such burning is usually intentional but sometimes accidental.

OPEN DUMP
The consolidation of waste from one or more sources at a central disposal site which has little or no management. Some of the problems associated with open dumps are: vector breeding, air pollution, water pollution, unsightliness, wasted land, disease and accident potentials.

ORGANIC REFUSE
Waste material made up of substances composed of chemical compounds of carbon in combination with other chemical elements, primarily hydrogen, and generally manufactured in the life processes of plants and animals. These materials include paper, wood, food waste, plastic, and yard wastes. Most organic compounds are a source of food for bacteria and are usually combustible.

ORGANISM
A form of life composed of mutually dependent parts that maintain various vital processes.

PAPER
The general name for all kinds of matter or felted sheets of fiber formed on a fine screen from a water suspension. More specifically, paper is one of two broad subdivisions, the other being paperboard, of the general term paper. Paper, usually lighter in basis weight, thinner, and more flexible than paperboard, is used largely for printing, writing, wrapping and sanitary purposes.

PAPERBOARD
Fiber sheets that are relatively heavier in basis weight, thicker, and more rigid than paper. There are three broad classes of paperboard: container board, boxboard, and such special types as automobile board, building board, and tube board.

PAPERSTOCK
A general term used to designate wastepapers that have bpen sorted or segregated at the source into various recognized grades. Paperstock is a principal ingredient in the manufacture of certain types of paperboard.

PARTICULATES
Suspended particles of ash, charred paper, dust, soot, and other partially burned matter carried in the residue of combustion.

PATHOGEN
Any infective agent capable of producing disease.

PULPWOOD
Roundwood cut from trees and prepared primarily for manufacture into wood pulp or wood fiber. This term does not include chips and sawdust produced as residues of lumber and plywood operations, but it does include chips manufactured from roundwood in the forest or at chipmills remote from a pulp mill.

PULVERIZATION
The crushing or grinding of material into small pieces. (See GRINDING and SHREDDER.)

PUTRESCIBLE
Capable of being decomposed by microorganisms with sufficient rapidity to cause nuisances from odors, gases, etc. Kitchen wastes, offal, and deal animals are examples of putrescible components of solid waste.

PYROLYSIS
The process of chemically decomposing an organic substance by heating it in an oxygen-deficient atmosphere. High heat is usually applied to the material in a closed chamber, evaporating all moisture and breaking down materials into various hydrocarbon gases and carbonlike residue. The gases may be collected with suitable equipment and used or sold. The residue may be further processed into useful materials - such as carbon, sand, and grit - or it can be landfilled.

RAW MATERIALS
Unprocesses materials as they come directly from the land.

RECLAMATION
The restoring of waste materials to usefulness. The reclaimed materials may be used for purposes that are different from their original usage.

RECOVERABLE RESOURCES
Any material that still has useful physical or chemical properties after serving a specific purpose and that can then be reused or recycled, either for the same purpose or for a different one.

RECOVERY
The process of obtaining usable materials or energy values from solid waste.

RECYCLING
A resource recovery method involving the collection and processing of a waste product for use as a raw material in the manufacture of the same product or a similar one. An example is the use of ground glass in the manufacture of new glass. (See CONVERSION, RESUE, and TRANSFORMATION.)

REDUCTION TECHNIQUES
Methods to lessen the quality of various materials in solid waste and to make them into a form suitable for reuse or disposal. (See BALING, COMPACTOR, CRUSHER, GRINDER, HAMMER MILL, and SHREDDER.)

REFUGE
A hiding place or shelter for rats, mice and insects. It is important to distinguish between refuge and refuse. Refuse means solid waste. The confusion comes about because refuse frequently serves as a refuge for vermin.

REFUSE
Putrescible and nonputrescible solid wastes, except body wastes. Includes garbage, rubbish, ashes, incinerator residue, street cleanings and solid market and industrial wastes. The term commonly used for all solid waste materials.

REFUSE SHED
A region or area which for reasons of topography, contiguous population and/or other common features, includes refuse sources which may be considered collectively in general planning. Usually synonymous with the general populated or metropolitan area, and not necessarily limited by lines of political jurisdiction.

RENDERING
A waste material recovery process in which the remains of animals and fish and other wastes from slaughterhouses and butcher shops are cooked and treated with a solvent to derive fats, oils, and a protein residue. The fats and oils are used to make soap, and the residue is used as feed for animals.

RESIDENTIAL WASTE
Waste materials discarded from houses and apartments.

RESIDUE
Solid materials that remain after gases and liquids have been removed by chemical or physical processes, such as burning, evaporation, distillation, or filtration comprising ash, metal, glass, ceramics, and unburned organic substances.

RESOURCE RECOVERY
The extraction and utilization of materials and values from mixed municipal waste. Materials recovered include metals and minerals that can be used in the manufacture of new products. Recovery of values includes energy recovery by utilizing components of waste as a fuel, production of compost using solid waste as a medium, and reclamation of land through sanitary landfills. (See CONVERSION.)

RESOURCE RECOVERY ACT OF 1970
An act of Congress that directs the federal government to emphasize resource recovery as a means of handling solid waste, to accept responsibility for research training, demonstrations of new technology, technical assistance, and grants-in-aid for state solid waste management agencies; and to create a National Commission on Materials Policy to recommend means for extraction, development and use of materials as susceptible of recycling, reuse, or self-destruction.

REUSE
The use of a waste material or product more than once. (See CONVERSION, RECYCLING, and TRANSFORMATION.)

RINGELMANN CHART
A printed or photograpghically reproduced series of four shades of gray, by which density of smoke emissions from an incinerator may be estimated. A clear stack is recorded as 0, and 100% black smoke as 5. No. 1 smoke is 20% dense; No. 2, 40% dense; No. 3, 60% dense; No. 4, 80% dense.

RUBBER
An elastic substance produced by coagulating the milky juices of various tropical plants. After being laid out in sheets to dry, the rubber can be modified by chemical treatment to increase its useful properties.

RUBBISH
Nonputrescible solid wastes. Includes ashes of both combustible and non-combustible wastes, such as paper, cardboard, tin cans, yard clippings, wood, glass, bedding, crockery, or litter of any king, but no food waste.

RUBBLE
Waste materials made up mainly of broken pieces of brick, cinder blocks, cement, or rock, but may also contain pieces of lumber or other construction materials. (See WASTE MATERIALS.)

RUNOFF
The portion of precipitation - rain or snow - or irrigation water that drains from an area as surface flow.

SALVAGING
The controlled removal of reusable materials.

SANITARY LANDFILL
A method of disposing of refuse on land without creating nuisances or hazards to public health or safety. This method required careful preparation of the fill area and control of water draining from it. Heavy tractorlike equipment spreads the waste in thin layers, compacts it to the smallest practical volume, and then covers it with at least six inches of compacted dirt at the end of each day. After the area has been completely filled up in this manner, covered with a final two to three foot layer of dirt, and allowed to settle an appropriate time, the reclaimed land may be turned into a recreational area, or under carefully controlled conditions, have certain types of buildings constructed on it.

SCAVENGING
The uncontrolled picking of materials in a disposal area, usually associated with an open dump.

SCRAP
Waste material that is usually segregated and suitable for recovery or reclamation. (See WASTE MATERIALS.)

SCREENING
Separating pulverized waste material into various sizes by using a sievelike device. This is usually done in two or more stages, each stage having a different mesh size.

SCRUBBER
A device that removes unwanted dust particles from an air stream by spraying the air stream with a liquid, usually water, or by forcing the air through a series of baths. (See ELECTROSTATIC PRECIPITATOR and MECHANICAL SEPARATOR.)

SECONDARY FIBER
Fiber used as a raw material for making new products. The fibers have been reclaimed from waste paper or collected during the manufacture of paper and paperboard products.

STACK (CHIMNEY, FLUE)
A vertical passage for conducting products of combustion to the atmosphere.

STEEL
An alloy of iron that contains in any amount up to about 1.7 percent as an essential alloying constituent. Steel is malleable under suitable conditions.

STERILIZATION
Destruction of all microorganisms and their spores outside the body by chemical or physical means.

STREET REFUSE
Material picked up by manual and mechanical sweeping of streets and sidewalks, litter from public receptacles, and dirt removed from catch basins.

SURFACE WATER
A body of water whose top surface is exposed to the atmosphere, including a flowing body as well as a pond or lake.

SWILL
Semi-liquid waste material consisting of garbage and free liquids.

THEORETICAL AIR
The exact amount of air required to supply oxygen for complete combustion of a given quantity of a specific fuel.

TONS PER DAY (INCINERATION)
Denotes the weight of refuse which can be properly processed by an incinerator within a 24 hour period. (See Capacity, rated)

TRANSFER STATION
A supplemental transportation system as an adjunct to route collection vehicles to reduce haul costs or add flexibility to the operation. A typical system has facilities in which route vehicles empty into a large hopper, from which open semi-trailers of about 80 cubic yards capacity or railroad cars are filled. There may be some compaction of refuse.

TRANSFORMATION
A resource recovery method involving the collection and treatment, by means other than biological or chemical, of a waste product for use as raw material in the manufacture of a different product. An example would be the use of recovered and ground-up glass in making bricks. (See CONVERSION, RECYCLING, and REUSE.)

TRASH
Waste materials that usually do not include garbage, but that may include other organic materials, such as plant trimmings. (See WASTE MATERIALS)

URBAN WASTE
All the waste materials generated from an urban area. (See WASTE MATERIALS.)

VECTOR
A living insect or other arthropod or an animal (not including humans) that transmits infectious disease from one person or animal to another. Open dumps provide a haven for vectors.

VIBRATING SCREEN
A mechanical device that sorts material according to size. Vibrating helps to prevent clogging and to move the material through the screen. Mechanical screens are used either wet or dry and in single or multiple decks.

VIRGIN MATERIAL
Any basic material for industrial processes that has not previously been used. (See PRIMARY MATERIALS and SECONDARY MATERIALS.)

VOLUME REDUCTION
The process waste materials in such a way as to decrease the amount of space the materials occupy. (See COMPACTOR and INCINERATOR.)

VOLUME REDUCTION PROCESSES
Reduction of solid waste is presently accomplished by four major processes: (1) mechanical, using compaction techniques (sanitary landfill, baling, etc.); (2) thermal, using heat (incineration, pyrolysis); (3) biological, using bacterial action to decompose organic waste (composting, aeration, etc.); and (4) chemical, using chemical agents such as acids, oxides, chlorine, and solvents to oxidize, neutralize, and otherwise alter the character of waste material. (See BIODEGRADABLE, COMPOSTING, INCINERATION, PRYOLYSIS, and SANITARY LANDFILL.)

VOLUNTARY RECYCLING (COLLECTION) CENTER
Generally, a volunteer-operated facility where the public can deposit separated waste materials, such as cans, bottles, and newspapers. These materials are then collected and taken to recycling facilities.

VOLUNTARY SEPARATION
The manual separation of glass bottles, food and beverage cans, or newspapers by individuals or groups of people, either at home or in local collection centers.

WASTE MATERIALS (SOLIDS)
A wide variety of solid materials that are discarded or rejected as being spent, useless, worthless, or in excess. This does not usually include waste solids found in sewage systems and waste resources or those emitted from smokestacks. Solid wastes are classed as refuse.

WASTE PROCESSING
An operation such as shredding, compaction, composting, and incineration in which the physical or chemical properties of waste are changed to reduced size or volume to make handling easier.

WASTE STREAM
A general term used to describe the total waste material generated by an area, a location, or a facility.

WATER TABLE
The level of the upper surface of groundwater. Wells may be drilled to this depth in order to obtain water for drinking and irrigation. (See GROUNDWATER.)

WATER-WALL FURNACE
A furnace with walls made of welded steel tubes through which water is circulated to absorb the heat of combustion. These furnaces can be used as incinerators. The steam or hot water generated may be put to a useful purpose or simply used to carry the heat away to the outside environment.

WINDROWING
The composting process of sorting and shredding refuse, placing it in long rows (usually five or six feet deep), and turning the piles for natural aeration. In modified windrowing, a quicker and more efficient method, controlled amounts of air are blown through the material being composted.

WOOD PULP
The basic primary material from which most papers are made. It consists of small, loose wood fibers mixed with water.

YARD WASTE
Grass clippings, prunings, weeds, and other discarded materials from yards and gardens.

FLORIDA PROJECTS

RESOURCE RECOVERY FACILITIES
STATE OF FLORIDA
JULY, 1980

GOVERNMENTAL

Agency	Process
Brevard County Solid Waste Systems 2500 Adamson Road Cocoa, Florida 32922	Shredding/metals separation/compaction
Metro-Dade County Solid Waste Disposal Division Department of Public Works Brickell Plaza Building Room 520 909 S.E. 1st. Avenue Miami, Florida 33131	Shredding/metals separation/electricity generation (under construction)
Pinellas County Solid Waste Management Public Works & Utilities 315 Court Street Clearwater, Florida 33516	Shredding/metals recovery/compaction (under construction)
Lakeland Utility Department Post Office Box 368 City Hall Lakeland, Florida 33802	Shredding/metals separation/refuse derived fuel (under construction)
U. S. Navy Post Office Box 5 Naval Air Station Jacksonville, Florida 32212	Refuse incineration/ steam generation
Monroe Co. Waste Collection & Disposal District Public Service Building Wing II Stock Island Key West, Florida 33040	Solid waste shredding and composting
U. S. Navy - Mayport Solid Waste Incineration Facility Post Office Box 266 Mayport, Florida 32228	Refuse incineration/ steam generation
Broward County Solid Waste Division Governor's Club Room 526, 236 S.E. 1st. Avenue Ft. Lauderdale, Florida 33301	Tire wreath for prevention of beach erosion

Solid Waste Section
Resource Recovery
Twin Towers Office Bldg.
2600 Blairstone Road
Tallahassee, FL 32301

FLORIDA SMALL-SCALE RECYCLING PROGRAMS
AS OF
JUNE, 1980

City/County Population	Material Collected	Estimated Tonnage Tons/Mo.	Contact Person
Boca Raton 58,000	Newspaper	250/month	Joyce Yelverton 305/395-1110
Deerfield Beach 42,000	Newspaper	No Info.	John Vogel 305/427-3331
Highland Beach 4,500	Newspaper & Cardboard	13/month	Elaine Roberts 305/278-4548
Lake Park 8,700	Newspaper	8/month	Scott Staples 305/848-3456
Leesburg 15,000	Newspaper	14/month	Jack Willard 904/787-4313
Maderia Beach 5,000	Newspaper	16	Ralph Rawson 813/391-9951
North Palm Beach 15,700	Newspaper	28	Charles O'Melia 305/626-0212
Palm Beach 10,000	Newspaper	21	Patrick Miller 305/655-5341
South Miami 11,850	Newspaper	No Info.	Jack Present 305/667-5691
Surfside 3,700	Newspaper		Richard Aiken 305/861-4863
Temple Terrace 12,000	Newspaper & Cardboard	16	Paul Aldridge 813/988-5111
Titusville 3,400	Newspaper	40	Bo Yarborough 305/269-4400
Vero Beach 17,000	Newspaper	92	Tom Nason 305/567-5151
West Palm Beach 70,000	Newspaper	100	Anita Spearman 305/659-8024

RESOURCE RECOVERY FACILITIES
STATE OF FLORIDA

PRIVATE

Company	Process
Waste Management, Inc. 2900 N.W. 48th Street Pompano Beach, Florida 33067	Methane production
Kaplan Industries, Inc. P. O. Box 427 Bartow, Florida 33830	Methane Production
Reynolds Aluminum Recycling Co. 6603 West Broad Street Richmond, VA 23261	Aluminum recovery
Auto-Shred Industries, Inc. P. O. Box 17009 Pensacola, Florida 32522	Metals recovery
Garden State Paper Co., Inc. 111 North Fourth Street Richmond, VA 23219	Paper recycling
I-U Conversion Systems, Inc. 115 Gibralter Road Horsham, PA 19044	Methane Production
Scientific Energy Engineering Co. 1722 Swan Street Jacksonville, FL 32205	Refuse/steam generation/ ash-cinder blocks
Anchor Hocking Glass Co. P. O. Box 6932 Jacksonville, Florida 32205	Glass recovery
Alton Box Board Co. P. O. Box 2146 Jacksonville, Florida 32203	Kraft paper recycling
Southern Scrap Co., Inc. P. O. Box 12388 Pensacola, Florida 32582	Metals recovery
Florida Steel Co. P. O. Box 518 Baldwin, Florida 32234	Metals recovery
American Glass & Recycling Co. 10244 New Kings Road Jacksonville, Florida 32219	Glass recovery

Company	Process
Walt Disney World Solid Waste Energy Conversion Reedy Creek Utilities Co., Inc. Post Office Box 40 Lake Buena Vista, Florida 32820	Refuse/gas production